



# aPriori Professional User Guide

Version 2019 R2

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## Document Information

*Last updated November 27, 2019*

*The latest version of this document can be found at the aPriori Support HelpCenter (requires registration): <https://support.apriori.com/hc>*

# CONTENTS

<b>About This Guide</b>	<b>xii</b>
Overview .....	M
Related documents .....	M
Typographic conventions .....	M
Feedback and customer support.....	N
<b>1 Introduction</b>	<b>1</b>
About aPriori.....	2
How We Do It.....	2
Value Proposition.....	2
Democratization of Cost.....	3
Technical details.....	4
Getting help.....	4
The aPriori interface.....	5
Navigation pane.....	6
Arranging the aPriori interface.....	7
Selecting a language for the aPriori interface.....	7
Special Characters.....	8
<b>2 Getting Started</b>	<b>9</b>
Technical requirements.....	10
Installing aPriori.....	10
Starting aPriori.....	10
Exiting aPriori.....	11
Uninstalling aPriori.....	11
<b>3 aPriori Cost Ticker Basics</b>	<b>12</b>
Starting the aPriori Cost Ticker.....	13
Costing a component in the aPriori Cost Ticker.....	13
Expanding the aPriori Cost Ticker.....	14
Switching to aPriori Desktop.....	15
aPriori Cost Ticker icons and command buttons.....	15
<b>4 aPriori Desktop Basics</b>	<b>17</b>
aPriori modes.....	18
CAD-Independent mode.....	18
Direct Integration mode.....	18
Active and inactive scenarios.....	18
Opening a component in aPriori.....	19
Opening a component from a CAD file or CAD system.....	19

Opening a component from the aPriori database .....	21
Initial costing: the Cost Guide.....	21
Production Scenario Tab, Basic options.....	24
Production Scenario Tab, Company-Defined Attributes.....	27
Production Scenario Tab, Targets .....	29
GCD Tolerances tab.....	30
Process and Machine Options Tab.....	32
What you can do at different stages.....	34
Costing with CAD Properties.....	35
Reconcile Inputs .....	36
Using the Search tool .....	37
Changing the file associated with a component.....	38
Copying cost settings from one component to another .....	39
Copying assembly cost settings to children .....	40
Using the Cost Object Info window .....	41
The Production Info tab .....	42
The Administrative Info tab .....	43
The Quoted Cost tab .....	43
Notes about purchased parts.....	44
Subsequent costing and costing with scenarios .....	45
Using the Cost menu .....	47
To cancel a costing operation .....	48
More About Costing.....	49
Component scenario tabs .....	49
Component Viewer .....	51
Cost outputs.....	52
Manufacturing process .....	53
Geometric cost drivers.....	53
Status messages.....	53
Saving cost information .....	54
Refreshing the database connection.....	55
Changing user preferences .....	55
Start aPriori with CAD application.....	56
One Click Costing™ (enabling/disabling auto-costing in response to CAD changes)..	56
Default Production Inputs.....	56
Cache New VPEs on Start-up.....	56
Default Scenario Name .....	57
Viewer .....	57
Use Official Scenarios in New Assemblies.....	57
Multi-Body Options .....	58
Displaying English units.....	59
Connecting to and disconnecting from CAD .....	61
Closing a component in aPriori Desktop .....	61
Switching to aPriori Cost Ticker .....	61
aPriori Desktop icons and command buttons.....	61
Cost Status Icons .....	63
aPriori Desktop table controls .....	63

<b>5</b>	<b>Using aPriori Desktop</b>	<b>65</b>
	Working with scenarios .....	66
	Using the Scenario Menu .....	67
	Creating and editing scenarios and snapshots.....	69
	Saving a scenario .....	70
	Working with initial scenarios.....	70
	Working with official scenarios.....	70
	Locking and unlocking scenarios.....	71
	Locking the scenario of a part or assembly.....	72
	Refreshing the current scenario.....	72
	Identifying types of scenarios .....	72
	Deleting a scenario.....	73
	Switching Scenarios in Assembly/Roll-up Details view .....	74
	Importing and exporting component costs .....	76
	Functional overview.....	76
	Basic workflow for sharing data.....	77
	Data Integrity: What happens when a part being imported already exists in the database.....	78
	Importing BOMs .....	78
	Using the component viewer tools and commands.....	78
	Displaying part characteristics .....	79
	Copying the component image to the clipboard .....	80
	Virtual welds.....	80
	Part setups for machining .....	83
	Turning axes .....	84
	Defining stock form and alignment for the Stock Machining and Bar & Tube process groups.....	84
	Defining draw direction for casting and injection molding.....	85
	Working with the Heat Map (Geometry Analysis) .....	86
	Using component viewer commands.....	92
	Specifying 2D Images for virtual components .....	92
	Controlling the resolution of the Component Viewer .....	93
	Controlling the colors of the Component Viewer .....	94
	Collaboration and Usability.....	94
	Using roll-ups .....	95
	Creating and editing roll-ups.....	95
	Cutting, copying, and pasting between roll-ups .....	98
	Using dynamic roll-ups .....	98
	Creating and editing dynamic roll-ups .....	99
	Using functional groups.....	101
	Reapplying functional groups templates .....	102
	Functional group naming conventions.....	102
	Best practices using functional groups .....	102
	Comparing the costs of alternative designs .....	105
	Creating and editing Comparison Summary views .....	105
	Creating new components without CAD.....	109

Working with non-CAD-based assembly components .....	111
Overriding computed values.....	112
A note about Cost Overrides and One Click Costing .....	112
Performing Part Details overrides.....	113
Show Formula Dependencies.....	115
Performing selective Cost Summary overrides .....	119
Performing total cost summary overrides .....	120
Precedence of production input overrides .....	121
Working with the Overrides Summary dialog .....	122
BOM reports .....	123
Spreadsheet Reports .....	124
Bulk editing components .....	124
<b>6 Access Control</b> .....	<b>125</b>
Access Control Overview .....	126
How it is implemented .....	126
How this might affect you .....	127
Error messages and log files.....	127
Using Search.....	128
VPEs.....	129
Access Control Principles.....	131
Some additional guidelines to remember.....	132
Additional details .....	132
Resources .....	132
Permissions .....	132
<b>7 Manufacturing Process Information</b> .....	<b>134</b>
Manufacturing process routing tree/table .....	135
Manufacturing process commands .....	136
Selecting a primary process group.....	137
Selecting material.....	138
Change material catalog .....	139
Change selection policy.....	139
Select material .....	140
Change material stock.....	140
Change material unit cost .....	141
Change material utilization .....	142
Editing production, administrative, or quote information .....	142
Specifying or importing tolerance and roughness values .....	143
How tolerances map to GCDs .....	144
How aPriori calculates achievable tolerance ranges.....	145
How aPriori determines cycle time adjustment factors .....	146
Using the Tolerance Policy Editor .....	147
Manually editing specific tolerances.....	151
Importing PMI from CAD.....	153
Notes about specific CAD systems and PMI.....	159
Editing yields .....	170

Good Part Yield and Final Yield .....	170
Viewing and setting Good Part Yield values.....	172
Calculations related to yield.....	174
Selecting a virtual production environment (VPE).....	174
Selecting a machine for an operation.....	175
Editing process setup options .....	177
Selecting a process routing .....	182
Viewing options.....	183
Understanding the legend .....	183
Expandable nodes .....	184
Selecting and editing a routing .....	184
Selecting alternative processes.....	185
Reverting to aPriori auto-selected routing .....	187
Using the right-click menu .....	187
Selecting an unfeasible machine for a process .....	188
Using the auto-select parent process command .....	189
No Cost Feature.....	189
Creating custom processes and routings .....	190
Creating a custom routing.....	191
Creating a custom operation sequence .....	191
Creating a custom process .....	193
Assigning operations to different processes.....	195
Highlighting associated GCDs.....	196
Specifying simultaneous operations.....	197
<b>8 Geometric Cost Drivers</b> .....	<b>198</b>
Overview .....	199
Working with large parts.....	199
Displaying GCDs.....	199
Geometric cost drivers tree/table .....	200
Editing values in the GCD properties table .....	201
Costing a component after editing GCD properties.....	201
GCD commands.....	202
GCD operation sequence selection.....	202
"Not Supported" GCD Messages .....	204
Operation sequence table .....	205
Viewing options.....	206
Understanding the legend .....	206
Expandable nodes .....	206
Selecting and editing an operation sequence.....	207
Selecting alternative operations .....	207
Using the right-click menu .....	209
GCD properties.....	210
GCD categories.....	210
Component GCDs .....	210
Base Properties .....	211
Blank.....	211

Main Surface .....	213
Parting Line .....	213
Subcomponents .....	214
Volume GCDs .....	214
Stock Trims .....	214
Bulk Removals .....	216
Pockets .....	217
Rings .....	217
Void .....	219
ComboVoid.....	220
AxiGrooves .....	222
Heligroove (Helical Groove) .....	225
SlideBundles .....	226
LifterBundles .....	226
Bending/forming GCDs .....	226
Bends.....	227
Multiple Bends .....	228
Forms.....	228
Lances.....	229
ShearForms .....	230
Ends.....	231
Holes GCDs .....	231
Simple Holes.....	232
Complex Holes.....	234
Multi Step Holes.....	236
Ringed Holes.....	237
Surfaces GCDs .....	237
Planar Faces .....	237
Curved Walls .....	239
Curved Surfaces.....	242
Sharp Edge.....	243
Weld GCDs .....	244
2-Model GCDs.....	247
GCD relations.....	247
Ends On .....	247
Intersects.....	248
Lies Near .....	248
Lies Outside .....	248
Parallel.....	249
<b>9 aPriori Cost Tables</b> .....	<b>250</b>
Overview of the cost tables .....	251
A note about Fully Burdened Cost .....	251
Part Summary tab .....	252
Component Information .....	253
Production Information.....	253
Material Information.....	254



Cost by Category (%) .....	255
Cost by Processes (%).....	256
Component Costs and Targets .....	257
Validation and Design to Cost .....	258
Prerequisites .....	258
Workflow.....	259
Validation and Design to Cost: Stock Machining .....	259
Notes and examples for Validation and Design to Cost.....	262
Thickness Violations in Casting and Plastic Molding Design to Cost.....	263
Cost Summary.....	266
Part Details and Assembly Details .....	268
Investment.....	272
Assembly tracker.....	272
Assembly process detail.....	273
Creating new views .....	277
Changing the Number of Decimal Places .....	278
<b>10 Bulk Costing and Analysis</b> .....	<b>280</b>
Overview .....	281
User inputs files.....	282
Process Setup Option columns .....	282
CSL Formula Override columns (non-custom processes only).....	283
Custom (User defined) Attribute columns .....	283
Pinned Routings .....	284
How to specify different datatypes in CSV files .....	288
Bulk costing groups of parts .....	289
Bulk costing part scenarios and assemblies .....	293
Deep costing assemblies .....	293
Costing multi-body parts (free bodies) .....	295
Bulk Costing 2-Model Machining Parts .....	296
Bulk costing data fields.....	297
Scenario support fields.....	298
Bulk costing required User Defined Attributes .....	299
Creating scenarios through Bulk Costing .....	300
Editing bulk costing inputs.....	300
Bulk Costing Menu Reference .....	301
Costing a bulk cost group .....	303
Costing with CAD properties .....	304
Costing without a CAD file.....	304
Associating an image without a CAD file.....	305
Cost Overrides .....	305
Reviewing bulk costing and analysis results .....	306
Running from the Command Line .....	308
bulkLoad.cmd .....	309
Syntax .....	309
Arguments.....	309
Example.....	309

Important Note About Forward And Back Slashes .....	309
bulkLoad.properties file .....	310
plugin.properties file .....	311
Running as a Scheduled Task .....	312
Bulk Costing Usage Reports (System Admins).....	312
Understanding cost failures during bulk costing.....	314
Improving performance .....	315
<b>11 Spreadsheet Reports</b> .....	<b>316</b>
Introduction to aPriori Spreadsheet Reports .....	317
Excel and Google Sheets Compatibility .....	318
When to Use Spreadsheet Reports.....	319
System-Defined Spreadsheet Reports.....	319
Custom Spreadsheet Reports .....	321
File types .....	321
Workflow.....	322
Creating a Custom Spreadsheet Report.....	322
Defining What You Want to Do .....	323
Editing XML Files .....	323
Complexity .....	323
To Generate XML or CSV Files.....	324
Elements of Report Files .....	324
Basic Structure of the XML File .....	324
The <reports> Tag .....	325
The <CostModelWatchPoints> Tag.....	325
The <node> Tag.....	326
The <CSL> Tag .....	326
The <Formula> and <Macro> Tags.....	327
Commonly Used Variables .....	327
Built-in Aggregation, Quoted Cost and other Formulas/Attributes.....	328
User Defined Attributes .....	329
Using the <Macro> Tag .....	329
Figuring Out What Variables to Use.....	330
Including part images and nesting diagrams in your report .....	331
Including information about scenario overrides.....	331
PivotTables.....	331
When to use PivotTables.....	332
Using More Filters .....	334
Installing and Running Custom Reports.....	336
From the GUI.....	336
By Copying.....	336
Caveats .....	336
Define a shared store (System Admins Only).....	336
Running from the Command Line .....	337
runAprioriReport.cmd.....	338
Troubleshooting FAQ .....	339
XML Configuration File Reference .....	340

Column Headings..... 341

<reports> ..... 342

    Attributes: ..... 342

    Child Elements:..... 343

<CostModelWatchpoints> ..... 343

    Attributes: ..... 343

    Child Elements:..... 344

<node> ..... 345

    Attributes: ..... 345

    Child Elements:..... 345

<OperationNodes> ..... 345

    Attributes: ..... 345

    Child Elements:..... 345

<CSL> ..... 345

    Attributes: ..... 345

    Child Elements..... 346

<Formula> ..... 346

    Attributes: ..... 346

<MACRO> ..... 346

    Attributes: ..... 346

<GcdTypes> ..... 346

    Attributes: ..... 346

    Child Elements:..... 347

<Gcd>..... 347

    Attributes: ..... 347

    ChildElements: ..... 347

<Attribute> ..... 347

**Glossary**

**348**



# About This Guide

This section provides information about this User Guide, and the other ways in which aPriori supports the aPriori application.

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Key topics include:

- Overview
  - Related documents
  - Typographic conventions
  - Feedback and customer support
-

## Overview

This User Guide contains detailed information about using aPriori to generate costs for parts and assemblies.

## Related documents

In addition to this guide, you can find more information about the aPriori application in the following documents:

- *aPriori Cost Model Guide* – This guide contains detailed information about process groups and includes a chapter on direct and indirect overhead. Note: This document contains chapters that formerly appeared in the *aPriori User Guide*.
- *aPriori Cost Model Workbench User Guide* – This guide explains how to use aPriori's Cost Model Work Bench (CMWB) to customize cost models
- *aPriori System Administration Guide* – This guide contains detailed information about administering the aPriori solution using the System Admin toolset. It is designed as a reference for aPriori system administrators.
- *aPriori VPE Administration Guide* – This guide contains detailed information about using the tools in the virtual production environment (VPE) toolset to maintain the VPEs in your aPriori deployment. It is designed as a reference for VPE administrators.
- *Release Notes* – This document highlights the changes made in aPriori since the previous release. It also contains last minute information about the release.
- *Installation Guide* – This guide contains detailed information about installing aPriori.
- *System Requirements* – This document provides information on the minimum and recommended client and server requirements to run aPriori, as well as the CAD file formats supported by aPriori.

## Typographic conventions

The following conventions are used in this guide to convey additional information.

Style	Description	Example
Code	Code style is used for text that is used literally, appearing exactly as shown. This includes command names, path and file names, and system information.	E:\setup.exe
<i>Italic code</i>	Italic code style is used for names of variables that you must provide. For example, you need to supply a value for <i>your_file</i> in the path name example to the right.	C:\aPriori\ <i>your_file</i>

<b>GUI</b>	GUI style is used to indicate objects in the aPriori interface.	the <b>Document</b> field
<b>GUI Action</b>	GUI Action style is used to indicate objects in the aPriori interface that you click, select, or otherwise act upon.	Click <b>OK</b> .

**Note** Notes highlight information, provide supplementary information, offer timesaving or easier ways to perform the same task, or explain how to prevent errors or data loss. Be sure to read this information carefully.

## Feedback and customer support

We appreciate your comments about this guide. Please contact us with your comments, questions, and requests for technical support.

Website: <http://www.apriori.com/support>

Email: [support@apriori.com](mailto:support@apriori.com)



# 1 Introduction

aPriori is a real-time, accurate cost management solution that allows designers, manufacturing engineers, purchasing/sourcing professionals, and management to estimate and control product costs throughout the product's entire lifecycle.

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Key topics include:

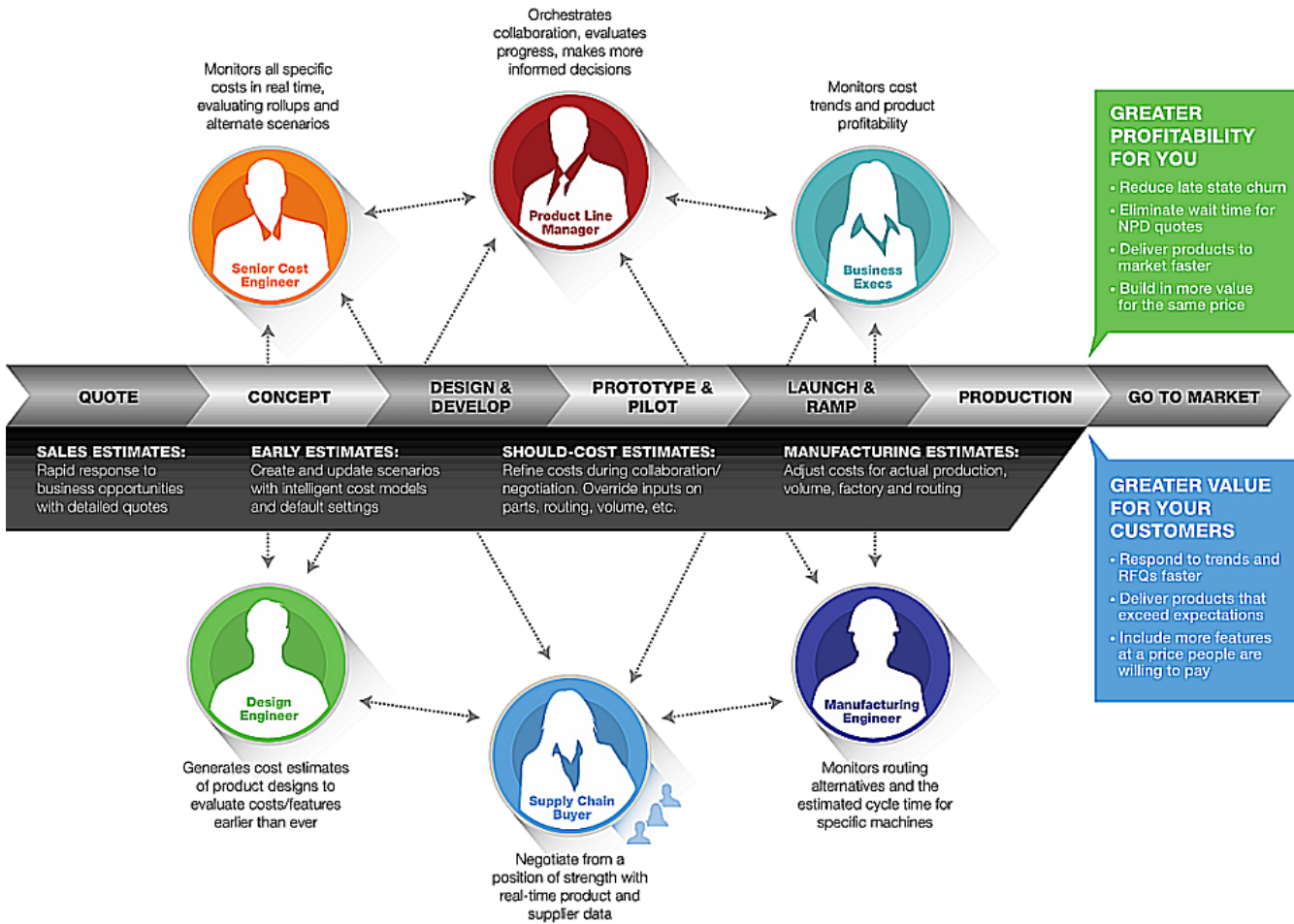
- About aPriori
  - Getting help
  - aPriori interface
-

# About aPriori

aPriori provides real-time visibility to product cost that helps you get from concept to customer faster, with a better product.

## How We Do It

aPriori’s product costing software generates detailed cost estimates and connects all members of your product team to relevant views of cost data – from sales to supplier, from concept to customer.



## Value Proposition

Real-time transparency to the cost of tradeoffs helps you avoid late stage design churn, get to market faster, meet target costs, and achieve your strategic product goals more consistently.

aPriori’s Product Cost Modeling (PCM) technology platform also helps you create a culture of profitability across your enterprise where people:



- **Sell Smarter** -- Knowing product cost before responding to customer RFQs lets you establish accurate quotes which eliminate surprises and yield more desirable margins.
- **Identify & Eliminate Cost Drivers Early** -- Design, Sourcing & Manufacturing cost drivers can be identified and eliminated before products reach the market, resulting in reduced late stage churn and improved product profitability.
- **Negotiate More Effectively with Suppliers** -- Awareness of “True Manufacturing Cost” enables sourcing teams to identify cost drivers and work more productively with suppliers and avoid overpaying for purchased parts.

## Democratization of Cost

A Product Cost Management platform provides early visibility to cost, consistency of costing practices across all members of the product team and higher throughput of cost optimized parts, all leading to a more cost-conscious culture where everyone is considering profitability with each decision they make.

Some of the key capabilities and benefits provided to core members of the product team include:

Group/Activities	Benefits/Outcome
<p><b>Design / Engineering</b></p> <ul style="list-style-type: none"> <li>▪ Generate cost estimates for individual components or complete BOMs representing logical functional groups and complete products.</li> <li>▪ Continuously monitor product designs against both cost and weight targets.</li> <li>▪ Identify and eliminate cost drivers early in the product development process</li> <li>▪ Compare alternative designs to identify optimal cost outcomes.(NPI and ECOs)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Launch new products at or below target cost/weight</li> <li>▪ Reduce the number of Value Engineering projects, and “get it right the first time”</li> <li>▪ Accelerate TTM by eliminating wait time for quotes on new product designs.</li> </ul>
<p><b>Sourcing</b></p> <ul style="list-style-type: none"> <li>▪ Evaluate multiple sourcing/manufacturing scenarios before sending an RFQ to suppliers</li> <li>▪ Understand true manufacturing cost before negotiating with suppliers</li> <li>▪ Cost optimize a larger volume of components/products using batch costing capabilities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Avoid overpaying for outsourced parts</li> <li>▪ Achieve annual cost reduction goals</li> <li>▪ Negotiate more effectively with suppliers by concentrating on manufacturing data vs. commercial pricing.</li> </ul>
<p><b>Cost Engineering</b></p> <ul style="list-style-type: none"> <li>▪ Conduct detailed cost analysis on complex components to identify and eliminate cost drivers</li> <li>▪ Cost optimize a larger volume of components/products using batch costing capabilities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Achieve or exceed annual cost reduction objectives, even with limited manpower</li> <li>▪ Increase value of individuals and the entire program by identifying greater savings for the company.</li> </ul>

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>▪ Amplify your cost knowledge throughout the enterprise by partnering with aPriori to refine and maintain cost models/data leveraged by the entire product team</li></ul> | <ul style="list-style-type: none"><li>▪ Effectively provide “at elbow” service to the product team by embedding your knowledge and experience in aPriori.</li></ul> |
|---|---|

## Technical details

To arrive at an accurate cost, aPriori models the physics of each machine used to manufacture a product. In a typical installation, aPriori requires the user to provide a limited number of inputs, including the high-level manufacturing process group (e.g., Sheet Metal fabrication or Casting), annual volume, and production life. Then aPriori automatically extracts most of the cost-driver data it requires from the CAD model of the part. Finally, aPriori uses a technique called Purpose Driven Geometric Assessment to determine manufacturing process, time, and cost.

aPriori does not require a CAD model for all costing operations. In cases where a CAD model is not available (such as competitive tear-down and analysis of a product), aPriori provides *User Guided Costing* where you can provide as much information as is known or can be estimated about a part product, and then calculate costs based on that available information.

aPriori can calculate costs by importing a CAD file from a wide variety of CAD systems into aPriori Desktop, or by running the Cost Ticker with the Pro/ENGINEER and Creo Parametric CAD applications.

When you import a CAD file, aPriori extracts geometry data from the file and allows you to perform all costing operations without accessing the originating CAD application. The costing information is saved in the aPriori database. aPriori provides the entire range of aPriori capabilities in a desktop application.

Running the aPriori Cost Ticker within a CAD application provides real-time response cost information for design changes to the current component. The aPriori Cost Ticker is displayed in a small window and provides a limited set of aPriori functions.

## Getting help

aPriori provides several different types of training and ELearning courses. Please contact aPriori Support or Professional Services for more information.

You can also get help from the aPriori **Help** menu. Select:

- **Help Contents** to display the aPriori documentation set in a web browser (Google Chrome, Mozilla Firefox, or Internet Explorer 8 through 11).
- **View License** to display the license expiration date as well as the processes, cost connectors, and features included in your license.
- **Explore Logs Directory** to display the **logs** folder in your aPriori installation directory. If you report an issue to aPriori Support, they may request the information in these files to help diagnose the problem.

**Note:** aPriori logs could contain unfiltered strings that have been entered by a user. To avoid the possibility of a cross-site scripting attack you should avoid using

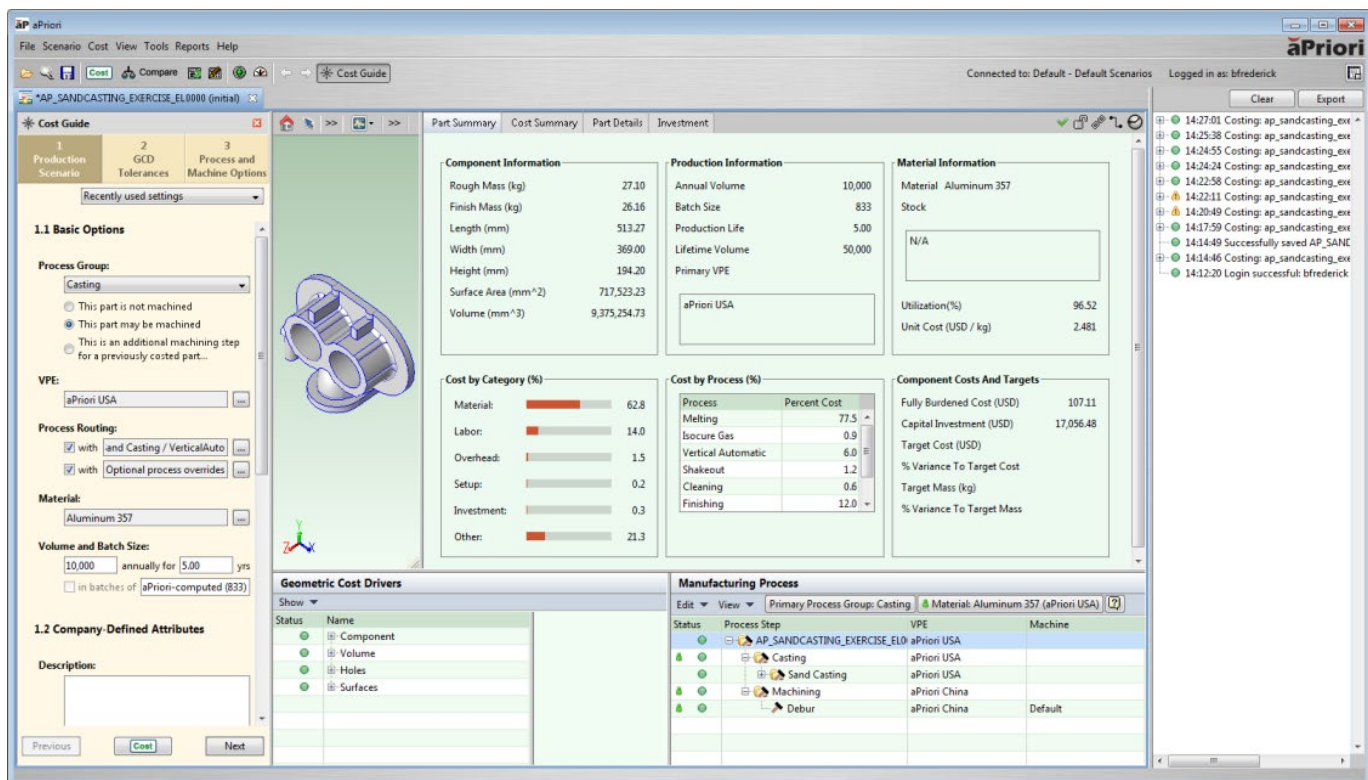
a browser-based utility to review logs. Instead, use a basic text editor such as Notepad.

- **aPriori Support** to log into the aPriori Support site.
- **About aPriori** to display the version number and copyright information.

## The aPriori interface

aPriori's graphical user interface (GUI) was designed to generally reflect Microsoft standards and contains the usual tool bars, buttons, and windows associated with every Microsoft-compliant graphical application.

As a result, only those features of the GUI that relate to performing aPriori-specific tasks are explained in this guide. We assume, for example, that you are familiar with standard Windows conventions, such as dragging a window's title bar to move the window or clicking the close button to close the window.



The aPriori Desktop is organized into the following areas:

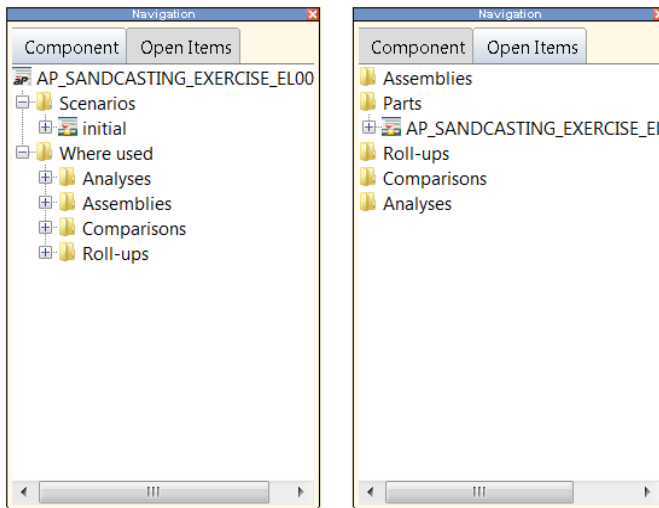
**Cost Guide** – Optionally displayed at the left side of the window. Assists you in providing information needed to make an accurate costing of the current component.

**Component scenario tab** – Typically displayed in the middle of the window. Lets you manipulate the component in 3D in a component viewer; displays cost information on the **Part Summary**, **Design to Cost**, **Cost Summary**, **Part (or Assembly) Details**, and **Investment** tabs; and allows you to modify the cost inputs on the **Manufacturing Process** and **Geometric Cost Drivers** panes.

**Message pane** – Displays information from aPriori as it evaluates the costs associated with alternative ways of manufacturing the component.

## Navigation pane

In addition to the default areas described above, you can also optionally display a floating **Navigation** pane, which provides two tabs: **Component** and **Open Items**.



The **Component** tab displays information related to the component in the current component scenario tab. It contains the following folders:

- **Scenarios** – Lists all scenarios associated with the current component. For more information, see *Working with scenarios* on page 66.
- **Where Used** – Lists all other components in which the current component is used. For example, a part may be included in an assembly, an analysis, a comparison, and a roll-up.

The **Open Items** tab lists all components currently open in aPriori Desktop, providing a quick mechanism for viewing and navigating across these components. The **Open Items** tab contains the following folders:

- **Assemblies** – Lists all open assemblies.
- **Parts** – Lists all open parts.
- **Roll-ups** – Lists all open Roll-ups.
- **Comparisons** – Lists all open Comparisons.
- **Analyses** – Lists all open Analyses.

Roll-ups and comparisons support drag and drop functionality. You can drag and drop components from the navigation pane to the active roll-up or comparison.

### To expand a folder in the navigation pane

Click the  icon.

### To open a component within a folder


Double-click the component or right-click the component and select **Open**.

All components in the navigation pane provide right mouse button support. The options available on the right-mouse menu vary based on the type of the component.

## Arranging the aPriori interface

You can show or hide the navigation pane and the message pane, select one of several layouts, and set aPriori's default layout.

### To show or hide the navigation pane

Select **View > Show Navigation** to display the navigation pane. Deselect **Show Navigation** (or click the red "X" (  ) in the upper-right corner of the window) to hide it.

### To show or hide the message pane

Select **View > Show Messages** to display the message pane. Deselect **Show Messages** to hide it.

### To select a layout

Select **View > Change Layout** then select a layout to adjust the display of the aPriori panes.

### To set the current layout as the default

Select **View > Use as Part Default Layout** to use the open layout as the default layout for parts. When you open a part, aPriori will use this layout.

## Selecting a language for the aPriori interface

The aPriori interface can be displayed in English, German, or (in SP1 and later) French. English is used unless your Microsoft Windows locale is set to Germany or France. You can set the Windows locale for your machine, or just for aPriori.

**Note** There are some minor limitations when using the foreign-language versions of aPriori. Certain items are not translated, including the names of specific VPE items, such as materials and machines, Excel report column headings, and certain costing error windows and messages. You can obtain a complete list of these items from aPriori Support. If your company is interested in making aPriori available in other languages, please contact aPriori Support.

### To set the Microsoft Windows locale for your machine

- 1 Select **Control Panel** from the Windows Start menu.
- 2 Click **Clock, Language, and Region**.
- 3 Click **Change location** under **Region and Language** to display the **Location** tab of the **Region and Language** window.
- 4 Select **Germany or France (SP1 and later)** from the **Current location** drop-down list and click **OK**.

All applications on your machine will use the specified locale.

### To set the Microsoft Windows locale for aPriori only

- 1 Open the `apriori.properties` file in your local aPriori installation directory.

**2** Add one of the following lines to the file.

To display aPriori in German, add  
`apriori.display.locale=de_DE`

To display aPriori in French (SP1 and later), add  
`apriori.display.locale=fr_FR`

To return the display of aPriori to English, remove the line above, or edit it to:  
`apriori.display.locale=en_US`

**3** Save the file.**4** Restart aPriori.

## Special Characters

In general, aPriori will accept the following characters when naming components or scenarios:

`!@#$%^&()_~=-+\}|{[]';:/?.,`

Note that the following characters are accepted but can cause problems later when exporting.

`><"*`

Likewise, `\` is accepted, but will not show up later when you search for a component.

Finally, there are a couple of restrictions for naming VPEs which are covered in the *VPE Administration Guide*.



## 2 Getting Started

This section describes aPriori's technical requirements, and how to install, start, exit, and uninstall the aPriori application.

---

Key topics include:

- Technical requirements
  - Installing aPriori
  - Starting aPriori
  - Exiting aPriori
  - Uninstalling aPriori
-

# Technical requirements

For detailed technical requirements, please see the *System Requirements* document. This document provides information on the minimum and recommended client and server requirements to run aPriori and the CAD file formats supported by aPriori.

## Installing aPriori

For information about installing aPriori, refer to the *aPriori Installation Guide*.

## Starting aPriori

You can start aPriori Professional Desktop in CAD-Independent or Direct Integration mode for Pro Engineer / Creo only.

**Note:** When starting aPriori, you may or may not see a login window asking you to enter a username and password. This behavior can differ depending on how your aPriori system administrator has configured your system. You should be given this information when beginning to use aPriori.

### To start aPriori Desktop in CAD-Independent mode

Click the aPriori icon  on your desktop.

### To start aPriori from NX, CATIA V5, or SolidWorks


If you have the "Cost in aPriori" plugin installed in your CAD tool, click the aPriori icon:



(These plugins are installed separately from the core product. If you are interested in using one, please contact your aPriori administrator. Note: The Catia and SW plugins are available for download from the aPriori Support Site. The NX Cost in aPriori plugin is delivered as a custom integration through aPriori Professional Services.)

This starts aPriori and opens and costs your CAD tool's current part. Your CAD tool may require you to specify whether to open and cost a single part or a group of part variations.

**Note:** If you initiated a component cost using "Cost in aPriori" via CAD, and you change the geometry of the component in your CAD application to recost the component,

press the aPriori icon  again. This step is required because if you try to update your cost directly in aPriori, the system will not be referencing the component's most up-to-date geometry.

You can also start aPriori and cost the current part by selecting a menu item:

- NX: Select **Cost in aPriori > Cost in aPriori**.
- CATIA V5: Select **Tools > Cost in aPriori > Cost in aPriori**.
- SolidWorks: Select **Cost in aPriori > Cost in aPriori**.




If the aPriori icon or menu is not visible in your CAD tool, you can make it visible as follows:

- NX: Select **Tools > Customize**, select the **Toolbars** tab, and check the **Cost in aPriori** checkbox.
- CATIA V5: Select **View > Toolbars > Cost in aPriori**.
- SolidWorks: Select **View > Toolbars > Cost in aPriori**.

To modify the folder in which your CAD tool looks for aPriori, do the following:

- NX: Select **Cost in aPriori > Options**.
- CATIA V5: Select **Tools > Cost in aPriori > Options**.
- SolidWorks: Select **Cost in aPriori > Options**.

### To start aPriori Desktop in Direct Integration mode for Pro Engineer / Creo Only

- 1 Start your CAD application. By default, the aPriori Cost Ticker starts automatically.
- 2 Click the  button in the aPriori Cost Ticker to switch to aPriori.

If you changed aPriori User Preferences to not start aPriori automatically with the CAD system, click the **aPriori** menu in the CAD system and select **Start aPriori** to start the Cost Ticker. If you added aPriori icon to the CAD system toolbar, click the aPriori icon to start the Cost Ticker.

## Exiting aPriori

Select **File > Exit** from the aPriori menu bar to exit aPriori.

## Uninstalling aPriori

For details about uninstalling aPriori, refer to the *aPriori Installation Guide*.



# 3 aPriori Cost Ticker Basics

This section provides basic information on how to use aPriori to calculate the cost of a part or an assembly using the Cost Ticker. In Direct Integration mode, aPriori starts as a Cost Ticker that can be expanded into aPriori Desktop. In CAD-Independent mode, aPriori starts as a Desktop that can be minimized into the Cost Ticker.



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This chapter includes the following topics:

- Starting the aPriori Cost Ticker
  - Costing a component in the aPriori Cost Ticker
  - Expanding the aPriori Cost Ticker
  - Switching to aPriori Desktop
  - aPriori Cost Ticker icons and command buttons
-

# Starting the aPriori Cost Ticker

## To start aPriori Cost Ticker in CAD-Independent mode

- 1 Click  on your Windows desktop or use the Windows Start menu to start aPriori Desktop.
- 2 Open a component in aPriori Desktop. See [Opening a component in aPriori](#) on page 19.
- 3 Click the  button in the top right corner of the aPriori Desktop tool bar to run aPriori as the Cost Ticker.

## To start aPriori Cost Ticker in Direct Integration mode

Start your CAD application. The Cost Ticker starts automatically.

**Note** You can disable auto startup by changing User Preferences in aPriori Desktop, see [Starting aPriori](#) on page 10 for more information.

# Costing a component in the aPriori Cost Ticker

The Cost Ticker displays a summary of a component's cost. When you open a component, the Cost Ticker's behavior depends on whether this component has been costed before.

By default, One Click Costing™ is enabled, which means that you must explicitly click the **Cost** button to cost the component. However, you can switch from One Click Costing to auto-costing, which means that aPriori will automatically cost a component whenever it is opened, activated, or changed in the CAD system. (This was the default behavior in earlier releases of aPriori). To enable auto costing in aPriori Desktop; see [One Click Costing™ \(enabling/disabling auto-costing in response to CAD changes\)](#) on page 56 for details.

## To cost a new component

- 1 Open the component.
- 2 By default, when you open a component that has never been costed before, aPriori displays a dialog directing you to open the aPriori desktop. Doing so causes the new part to be opened in the Cost Guide which helps you provide the necessary information to perform an initial costing.
- 3 As of Release 2018 R1 SP1, the **Cost** button will be enabled in the Ticker even for new parts *if* your aPriori system administrator has configured your installation to automatically import CAD properties and *all* inputs needed to cost a part have been successfully mapped (Process Group, VPE, Material , and Annual Volume). This

enables Design Engineers to generate initial cost estimates while keeping their focus their CAD windows and design-related tasks. Note that Batch Size is *not* required to be set to enable the Ticker **Cost** button. If Batch Size is not available through CAD properties, the value is determined by the default aPriori mechanism of computing it as a fraction of Annual Volume.

For more information about mapping CAD properties, see the chapter “Using CAD Properties in the 2018 R1 SP1 (or later) aPriori Professional *System Administration Guide*.”

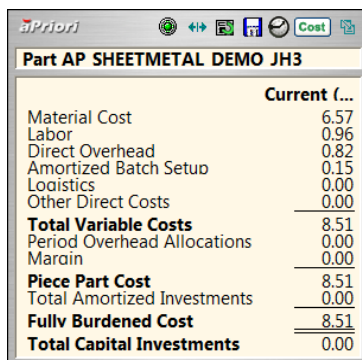
For information about using the Cost Guide, see [Initial costing: the Cost Guide](#) on page 21.

### To cost a previously costed component

- 1 Open the component.
- 2 If the component has been costed before, the Cost Ticker displays the last saved cost values for the component. The stale clock icon 🕒 and gray background color indicate that the cost information is not current.
- 3 Click **Cost**.

aPriori displays progress messages during the costing process.

When the costing is done, the cost values are displayed.



	Current (...
Material Cost	6.57
Labor	0.96
Direct Overhead	0.82
Amortized Batch Setup	0.15
Logistics	0.00
Other Direct Costs	0.00
<b>Total Variable Costs</b>	<b>8.51</b>
Period Overhead Allocations	0.00
Margin	0.00
<b>Piece Part Cost</b>	<b>8.51</b>
Total Amortized Investments	0.00
<b>Fully Burdened Cost</b>	<b>8.51</b>
<b>Total Capital Investments</b>	<b>0.00</b>

The clock icon and the background color indicate that the cost information is current.

## Expanding the aPriori Cost Ticker

### To expand the aPriori Cost Ticker

Click the 🔄 button.

In addition to the current cost of the component, the expanded Cost Ticker shows the previous cost and the last saved cost.

	Current (USD)	Previous (USD)	Saved (USD)
▼ Material	0.04	0.10	0.26
▼ Labor	0.11	0.10	0.12
▲ Direct Overhead	0.39	0.33	0.45
▼ Other Direct	0.17	0.52	0.06
<b>▼ Total Variable</b>	<b>0.71</b>	<b>1.05</b>	<b>0.89</b>
▼ Amortized Investments	0.57	0.66	0.75
<b>▼ Total Fixed &amp; Variable</b>	<b>1.28</b>	<b>1.70</b>	<b>1.64</b>
▼ Period Overhead	0.00	0.00	0.00
<b>▼ Fully Burdened Cost</b>	<b>1.28</b>	<b>1.70</b>	<b>1.64</b>
▼ Total Capital Investment	15,681.86	18,034.14	20,664.98

A green arrow to the left of the cost component indicates the cost has gone down since the last update, and red arrow indicates that the cost has gone up.

**To contract the aPriori Cost Ticker**

Click the button in the expanded Cost Ticker.

## Switching to aPriori Desktop












**To switch to aPriori Desktop**

Click the button.

## aPriori Cost Ticker icons and command buttons

The following table lists all the icons and command buttons available in aPriori Cost Ticker and explains how they are used.

Icon	Usage
	<p>Click this button to display system messages. The color of the Message button indicates the system status:</p> <ul style="list-style-type: none"> <li>Green – the part has been costed successfully without errors.</li> <li>Yellow – a warning has been produced during costing</li> <li>Red – an error has occurred during costing</li> </ul> <p>Close messages to return to the Cost Ticker.</p>
	<p>The Cost Target icon is displayed only if the target cost for the component is set. You can set the target cost for a component by editing the component's Production Info in aPriori Desktop, see Initial costing: the Cost Guide on <a href="#">page 21</a> for details. If the target cost is set and the current cost is:</p> <ul style="list-style-type: none"> <li>Between 90% and 110% of the target cost, the indicator on the Cost Target icon points straight up</li> <li>Less than 90% of the target cost, the indicator points to the left</li> <li>More than 110% of the target cost, the indicator points to the right</li> </ul>

	<p><b>Note</b> You also can set the target mass (weight) for a component in the Production Info window, but the Cost Target icon only reflects actual vs. target cost status.</p>
	Click this button to expand the Cost Ticker.
	In the expanded Cost Ticker, click this button to contract the Cost Ticker.
	<p>This button is available in Direct Integration mode only. Click this button to access the Geometric Cost Drivers (GCDs) options:</p> <ul style="list-style-type: none"> <li> Select this option to refresh the GCDs from the CAD model and calculate new cost using the updated GCDs. Place the mouse pointer over this icon to see the date and time when the GCDs were last updated.</li> </ul> <p><b>Note</b> In CAD-Independent mode, this option is available directly from the tool bar.</p> <ul style="list-style-type: none"> <li> Select this option to view the GCDs for the component. When you select this option, the Cost Ticker closes and the aPriori GCDs window is displayed. For details about GCDs, see <i>Geometric Cost Drivers on page 198</i>. To return to the Cost Ticker, close the GCDs window</li> </ul>
	<p>Select this option to refresh the GCDs from the CAD model and calculate new cost using the updated GCDs.</p> <p><b>Note</b> In CAD-Independent mode, this option is available from the tool bar. In Direct Integration mode, this option is available from the GCDs Options menu.</p>
	Click this button to save the cost object and the displayed cost. If the displayed cost is not current, the Save button is not available.
	This icon indicates that the displayed cost is current, which means that the component has not changed since this cost was last calculated. Place the mouse pointer over this icon to see when the displayed cost was last saved.
	This icon indicates that the displayed cost is not current; the component has been changed since this cost was calculated. Place the mouse pointer over this icon to see when the displayed cost was saved. When the cost is not current, the Cost Ticker window is dark grey and the <b>Save</b> button is disabled.
	Click this button to cost a component.
	Click this button to switch to aPriori Desktop. For more information, see <i>aPriori Desktop Basics on page 17</i> .



# 4 aPriori Desktop Basics

This section provides basic information on how to use aPriori to calculate the cost of a part or an assembly using the aPriori Desktop.

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This chapter includes the following topics:

- aPriori modes
  - Initial costing: The Cost Guide
  - Using the Search tool
  - Changing the file associated with a component
  - Copying cost settings from one component to another
  - Using the Cost Object Info window
  - Component scenario tabs
  - Status messages
  - Saving cost information
  - Refreshing the database connection
  - Changing user preferences
  - Connecting to and disconnecting from CAD
  - Closing a component in aPriori Desktop
  - Switching to aPriori Cost Ticker
  - aPriori Desktop icons and command buttons
  - Cost Status Icons
  - aPriori Desktop table controls
-

# aPriori modes

aPriori Desktop works in CAD-Independent mode or Direct Integration mode.

## CAD-Independent mode

In CAD-Independent mode, aPriori retrieves the component's geometry from the imported CAD file. Once a component's geometry has been saved in the aPriori database, you can work with the component in file-connected or in file-disconnected mode.

In file-connected mode, aPriori locates the CAD file that provides the component's geometry and constantly monitors the state of this file. Any change in the CAD file is immediately reflected in aPriori, which allows you to refresh component's GCDs as soon as component's geometry changes. You can perform any aPriori operation that requires regenerating GCDs on a file-connected component.

In file-disconnected mode, you work only with component's data saved in aPriori database. In this mode you cannot refresh component's GCDs, thus you are limited to those aPriori operations that do not require regenerating GCDs.

Note that with 2-Model Machining (see the chapter 2-Model Machining Process Group in the *aPriori Professional Cost Model Guide*), you must be CAD-file connected to *both* the source and finished CAD models in order to extract GCDs. If you change the source scenario specified in the Production Scenario tab of the Cost Guide, both the new source scenario and the current finished scenario should be CAD-file connected; if either is not, aPriori disables Save for the current finished scenario, and any subsequent costing relies on GCDs extracted using the old source scenario.

## Direct Integration mode

In Direct Integration mode, aPriori retrieves the component's geometry directly from the CAD application and constantly monitors its status. This allows you to refresh the component's GCDs as soon as the component's geometry changes. In Direct Integration mode you can perform any aPriori operation that requires regenerating GCDs.

You can open multiple components in aPriori Desktop in Direct Integration mode. However, the component that is active in the CAD application is treated differently in the following ways:

- In the CAD application, the aPriori menu is only available for the active component.
- In aPriori, you cannot close the component that is active in the CAD application.

## Active and inactive scenarios

You have additional control over when CAD-connected (file-connected or direct-integration) components get updated with CAD changes. You can specify that a scenario is either Active or Inactive. If you set a scenario to "Inactive", it will not automatically update from CAD changes unless you explicitly tell aPriori to refresh its GCDs. This can make costing operations go faster, but you run the risk of not capturing recent updates to the CAD model.



When switching to an inactive sub-component scenario in an assembly (see *Switching Scenarios in Assembly/Roll-up Details view on page 74*), aPriori will warn you:

**“You have selected a scenario that is not active (connected to CAD) and may have different geometry than the component that is in this assembly. If you continue, then the component scenario's geometry may be different than the component's geometry in this assembly (which is connected to CAD). Do you wish to continue?”**

**Note:** In releases prior to 2014R1, the “official” scenario of a subcomponent in an assembly was always considered “active” while other scenarios were automatically considered “inactive. The concepts of “official” and “active” are now separate, and you can control them independently.

## Opening a component in aPriori

When you open a component in aPriori Desktop, a new scenario tab opens for the component. The name of the component is shown on the tab label. The name of the scenario is shown in parenthesis next to the component name.

The component also displays in the Navigation pane if displayed.

You can open multiple components and multiple scenarios for the same component in multiple tabs. To switch from one component or scenario to another, click on the corresponding tab. In Direct Integration mode, you can also switch to a component by activating the component in the CAD tool. See also Component scenario tabs [on page 49](#) and *Working with scenarios on page 66*.

**Note:** You cannot simultaneously open two parts with the same name, but which exist in different directories. One example of this situation is obvious: if you open a component in aPriori, and then try to open a same-named component from a different directory, aPriori displays an error message. A less obvious example of this situation can occur with assemblies: If you have a CAD assembly that has subcomponents with the same name but which reside in different directories, and you try to open this in aPriori, you will get an explanatory error message. To work around this situation, you must ensure that the CAD assembly does not specify same-named sub-components from different directories.

## Opening a component from a CAD file or CAD system

You can open an MCAD component, a part or an assembly, from:

- A CAD file, in CAD-Independent mode.
- A CAD system, in Direct Integration mode.

### To open a part in CAD-Independent mode

- 1 Select **File > Open CAD file...** The Open CAD file browser opens.
- 2 Browse to the directory that contains the desired part CAD file.

If the directory contains CAD files with the same name and same file type extension, but different numeric extensions that follow the file type extension, only the latest file will appear in the Open CAD file list box. For example, if the directory contains files

cadfile.prt.1, cadfile.prt.2, and cadfile.prt.3, numbered chronologically, only cadfile.prt.3 will appear in the Open CAD file list box.

- 3 Select the part CAD file.
- 4 If you want to open the default (typically “Initial”) scenario, proceed to the next step and open the file. If you want to open a different, existing scenario, first type its name in the “**Scenario name:**” field at the bottom of the Open CAD File dialog. If you want to create a new scenario for the component, enter it in the “**Scenario name:**” field. Note that the “**Scenario name:**” field cannot be blank. For more information about scenarios, see *Working with scenarios* on page 66.
- 5 Click **Open**. The part opens in aPriori Desktop.


When you open a component, the *official scenario* for the component opens by default. To open a different scenario, you must manually select it from the list of the component scenarios on the Component tab of the navigation pane. For more information, see *Working with scenarios* on page 66.

### To open an assembly in CAD-Independent mode

- 1 Select **File > Open CAD file...** The Open CAD file window opens.
- 2 Select an assembly file using the same procedure described above and click **Open**. aPriori locates all the part files that belong to the assembly. If all the part files are found, the assembly opens in aPriori Desktop.

The assembly components are listed in the Assembly Costs Tab and you can navigate the full assembly structure there. To open a component from the list, double-click it or select an action from the right-click menu. If the component has never been costed before, the **Cost Guide** is displayed (see *Initial costing: the Cost Guide* on page 21.)

A component opened from the list of components of a file-connected assembly, also becomes file-connected.


If the CAD file is moved to a different location or deleted while you are working with a component opened from this file, the component becomes file-disconnected. The  icon in the aPriori tool bar becomes greyed out.

### To open a component (part or assembly) in Direct Integration mode

- 1 Open the component in your CAD application.

**Note:** In Direct Integration mode, the scenario, the default scenario name specified in **User Preferences** is automatically used for newly opened and costed components.


- 2 Cost the component in aPriori. For more information, see *Initial costing: the Cost Guide* on page 21.

The  icon on the component scenario tab in aPriori Desktop indicates that this component is active in the CAD application.

## Opening a component from the aPriori database

Once you have saved the costing information for an MCAD component or created and saved a roll-up, a comparison, or an analysis in aPriori, you can open any of these components from aPriori database.

### To open a component from the aPriori database using the Search tool

- 1 Click the **Search** button  or select **File > Open**. The Search window opens.
- 2 Enter search criteria in the filter fields and click **Find**. The list of components and their scenarios that match the filter criteria is displayed. See *Using the Search tool on page 37* for more information.
- 3 Select the component scenario that you wish to open.
- 4 Click **OK**.

### To open a recently saved component

- 1 Select **File > Open Recent**. The list of recently saved components is displayed.
- 2 Select a file from the list.

### To open a component from the navigation pane

When an open component has other components associated with it, those components are displayed in the navigation pane. Click on a component in the navigation pane to open the component in a new tab.

- In CAD-Independent mode, when you open a part or an assembly from aPriori database, aPriori attempts to locate the corresponding CAD file:
- If the CAD file is found in the folder from which it was opened last time, the part or assembly becomes file-connected.

If the CAD file is not found in the specified location, the part or assembly is file-disconnected.

In Direct Integration mode, the component that you open from aPriori database is not connected to the CAD system. Only the component that is active in the CAD system is connected.

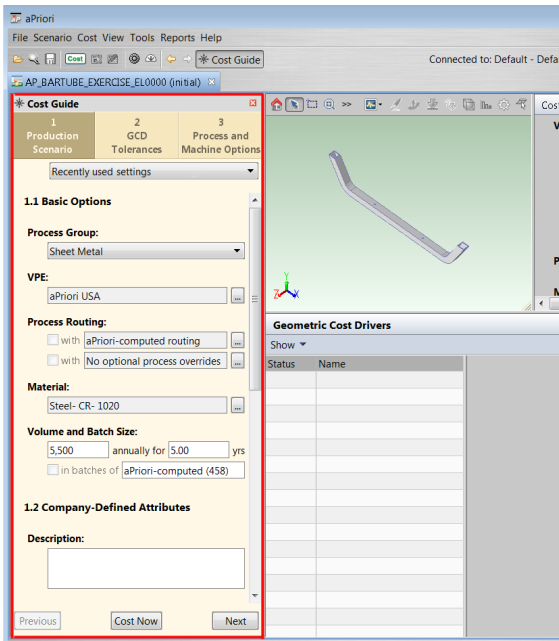
### To open the most recent scenario (keyboard shortcut)

To open the latest (“most recent”) scenario, use the shortcut keyboard sequence:

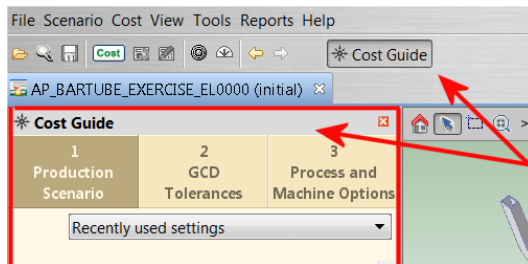
Ctrl-Shift-L

## Initial costing: The Cost Guide

When you open a component that has never been costed before, aPriori displays the **Cost Guide** at the left side of the desktop. The Guide is a wizard-like interface, divided into three tabs that guide you to enter the production, tolerance, and machine & process information needed to generate an accurate costing for the component.



The display of the Guide is controlled by the **Cost Guide** button and the **Cost Guide** toolbar.



The **Cost Guide** is displayed when the button is set and is hidden when the button is not set, or when you click the “X” button (✕) in the toolbar. (You can also use the **View > Show Cost Guide** menu option.)

**Note:** The **Cost Guide** is always displayed when costing a component for the first time, regardless of the setting of the **Guidance** button.

The **Cost Guide** is useful not only for initially entering cost inputs but also for refining those inputs. You may wish to leave it open most of the time.

The **Cost Guide** incorporates and combines features and tools that are found throughout the aPriori GUI and presents them in order in one place so that your initial costing can be more complete and more accurate. Experienced aPriori users will find that many tasks that you formerly performed in different areas of the UI are now much more easily accessed through the **Cost Guide**. Some of these areas include:

- Production information (otherwise entered on the **Production Info** tab of the **Cost Object** window).
- Administration information (otherwise entered on the **Administrative Info** tab of the **Cost Object** window).
- Routing choices, presented as a simplified version of the aPriori **Routing Selection** window (otherwise specified from the **Manufacturing Process** panel **Edit > Routing**

**Selection** menu). This simplified version emphasizes primary routing alternatives.

- Secondary process choices such as Heat Treatment or Surface Treatment processes, presented in an easy-to-navigate check-box format (otherwise specified by including these secondary processes within the aPriori **Routing Selection** window (see *Selecting a process routing on page 182*).

**Note:** The reason for this organization of primary routing choices and optional secondary process choices in the Cost Guide is so that you would not be required to go into the full routing editor to add secondary processes. However, this behavior can be customized by a process node attribute -- “displayInSPDialog” -- which administrators can modify in the Cost Model Workbench:

Nodes with the “displayInSPDialog” node attribute set to TRUE will appear in the Secondary Process dialog and NOT be displayed in the Simplified Routing Editor

Nodes with the “displayInSPDialog” node attribute set to FALSE (or not defined at all) WILL appear in the Simplified Routing Editor and not the Secondary Process dialog.

Refer to the node attributes section of the *Cost Model Workbench Guide* for more information.

- Tolerance policy and/or tolerances on individual GCDs (otherwise specified from the **Manufacturing Process** panel **Edit > Tolerance** menu, or from the context menu on individual GCDs in the **Geometric Cost Drivers** panel).
- Process setup options (otherwise specified from the **Manufacturing Process** panel **Edit > Process Setup Options** menu).
- Machine Selection (otherwise specified from the **Manufacturing Process** panel **Edit > Machine Selection** menu).

You do not need to provide every possible value to the **Cost Guide**. In fact, you could perform an initial costing with little or no input to the **Cost Guide** at all – the **Cost Guide** will not force you to enter values, although it will prevent you from using the **Process and Machine Options** tab until the component has been costed at least once. Such a premature costing would not be accurate, but the point is that the **Cost Guide** is provided to make it obvious what cost factors you should consider, and make it easy for you to specify those inputs that you decide to provide, when you are ready to provide them.

To navigate within the **Cost Guide**, you can use the **Next** and **Back** buttons at the bottom of the window to proceed to the next logical tab or to return to the previous one. You can also proceed directly to a specific tab by selecting the tab labels at the top of the window.

**Note:** At any time, you can see the inputs you have provided to the **Cost Guide** by going to the **Manufacturing Process** panel in the aPriori desktop and clicking **Edit > Cost Overrides Summary**. You can also reverse all your overrides from here by clicking the **Clear All Overrides** button at the bottom of the window. For more information about the **Cost Overrides Summary** window, see *Working with the Overrides Summary dialog on page 122*.

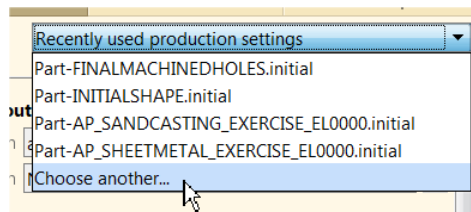
The following sections will step you through the various **Cost Guide** tabs and fields.

## Production Scenario Tab, Basic options

The first (“**Production Scenario**”) tab is divided into sections for gathering important, basic information about your component for costing.

**Note:** Your aPriori System Administrator may have customized this tab so that the fields and groupings reflect your company’s standards and workflows. This section describes how this Cost Guide tab appears out of the box and may differ from what you see on your screen. For more information, see the “Managing Dialog Views” section of the *aPriori Professional System Administration Guide*.

**Recently used settings:** If you have already costed other components and can use their values as a starting point for the current model, use this pull-down menu to either select a specific component, or select **Choose another...** to bring up the **Search** tool to find it (see *Using the Search tool on page 37*).



Selecting a previously-costed component populates the **Cost Guide** with the values used for that previous costing, and you can either use them as is, or modify them for your current component.

In general terms, **Recently Used Settings** copies everything. More specifically, it copies all inputs provided for the previous scenario and tries to apply them to the new scenario. All routings and processes are copied, even if they do not apply to the new scenario. For example, if you copy from a scenario with 3-Axis Mill pinned, and 3-Axis Mill is not feasible for the new scenario, the routing will be copied, but it will fail costing.

For operation/GCD-level settings, aPriori tries to do some geometry matching to find similar features in similar locations. For example, if you have a hole that has a tolerance in your source model, and you copy those settings to a model where the hole has moved

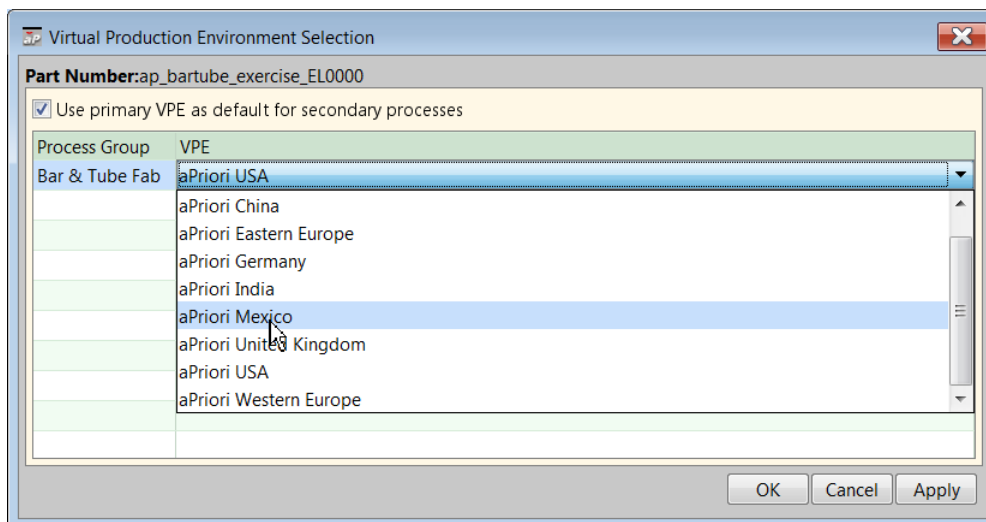
a small amount, the match will probably succeed. However, if the hole has moved across the whole part, the match will probably fail.

**Note:** This functionality applies only to parts, NOT assemblies. However, you can copy welds between assemblies as discussed at [To copy virtual welds](#).

**Process Group:** Perhaps the single most important setting you need to consider is the **Process Group** selection. When aPriori first encounters a new CAD file, it has no way of automatically determining what kind of component it is. So if, for example, you open a model of a roto-molded plastic milk jug, and do not change the Process Group setting from the default value of **Sheet Metal** to **Roto & Blow Molding** before costing the component, aPriori will do its best to route the milk bottle through a sheet metal process. Obviously the results will not be particularly useful. So, the first thing you should always do when preparing to cost a new component is to select the appropriate process group.

**Note:** When you select **Manually Costed** from the **Process Group** drop-down menu, a **Currency** field also gets displayed, allowing you to change the displayed currency. Additional options may also be displayed in this section when you select the **Casting**, **Forging**, or **2-Model Machining** process groups. See the *aPriori Cost Model Guide* for an explanation of these additional options.

**VPE:** The Virtual Production Environment (VPE) is a cornerstone of aPriori costing: this represents a virtual factory that typically defines production capabilities and related production cost factors such as available machines, process routings, speeds & feeds, labor rates, and so forth, at one physical location. aPriori provides a set of Starting Point VPEs (formerly called "Baseline VPEs"), which typically are modified at each user site as needed. If you need to change to a different VPE (for example, if the component is to be manufactured in Mexico instead of the USA), click the "..." button to display the **Virtual Production Environment Selection** window.



If you specify a secondary process such as painting, you can control the selection of the VPE for that secondary process either automatically or by manually selecting it as follows:

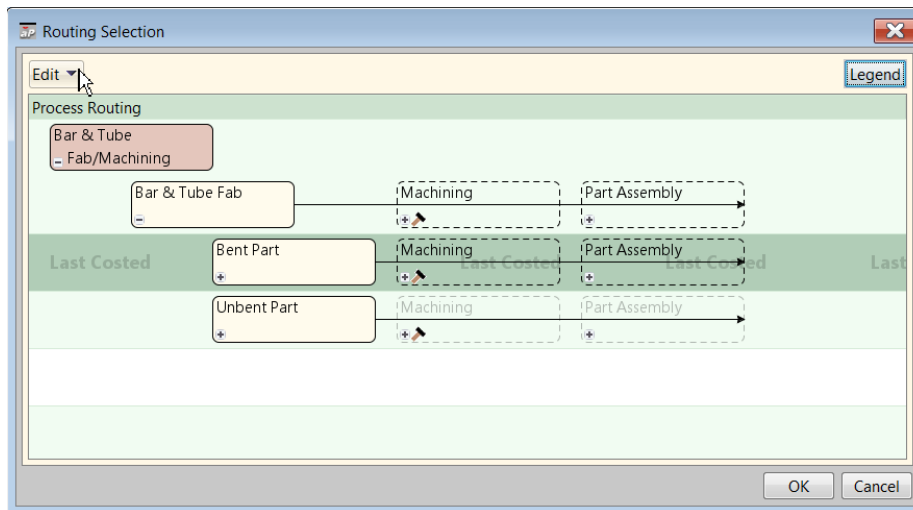
- If you want the secondary process to be completed in a specific, different area than the primary process, select that VPE for that secondary process the same way you do as for the primary process.

- If you want to automatically use the default VPE for that process, leave **Use primary VPE as default for secondary processes** unchecked. aPriori will use whatever default has been defined for that process. (These defaults can be set using **Tools > VPE Toolset > Deployment Data > Process Groups**.)
- If you want secondary process to be costed using the same VPE as the primary process, check **Use primary VPE as default for secondary processes**.

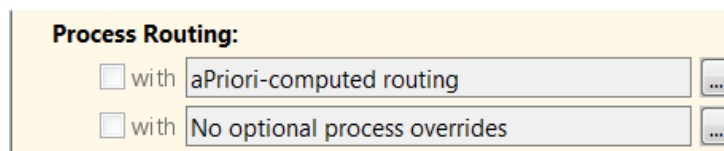
Administrators can find more information about VPEs and how to customize them in the *VPE Administration Guide*.

**Process Routing:** Process routing is the sequence of manufacturing steps that a component must go through to be created. Typically, there are several primary alternative routings with differing costs that could be used to accomplish the same end-result. For example, a cast component may be created by either sand-casting, die-casting, or permanent-mold casting routings. There are also secondary processes such as heat or surface treatments that can be added after the main work on the component has been completed. The default is to have aPriori analyze the various possible routing options for a component, determine which are feasible from a manufacturing perspective, and of these then choose the most cost-effective one. However, you may be aware of specific constraints that make a specific routing necessary.

To specify the routing, click the “...” button next to **aPriori-computed routing** to display the compact **Routing Selection** window. (This is a smaller, simplified version of the complete Routing Selection window available from the **Manufacturing Process** panel **Edit > Routing Selection** menu. It shows only primary routing alternatives and not secondary processes such as Heat Treatment or Surface Treatment)

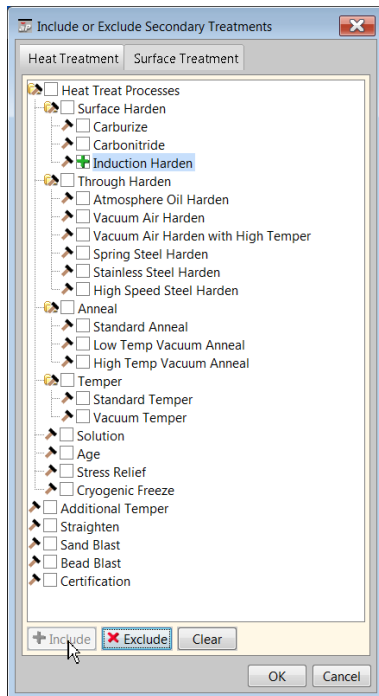


You can also specify secondary processes from the **Cost Guide** by clicking the “...” button next to the second option under the **Process Routing** section (with the default **No optional process overrides** setting).



This displays the **Include or Exclude Secondary Treatments** window.





Select the treatment that you wish to control and then click either **Include** or **Exclude** at the bottom of the window. Click **OK** when done.

**Material:** Clicking the “...” button next this field brings up the **Material Selection** window that is also available from the **Manufacturing Process** panel **Edit > Material Selection** menu. Use this to override the default stock chosen by aPriori. See [Selecting material on page 138](#) for information about using this window.

**Volume and Batch Size:** The values for volume and years are generally self-explanatory: how many units of this component do you expect to produce annually, and for how many years? The batch size value is typically the expected monthly rate, and so is usually calculated as  $\text{volume}/12$ . The batch value is used in many of the calculations shown in each of the process group chapters. You can either have aPriori automatically calculate the batch value or specify it yourself if the field is enabled via preferences. Default values for all these settings are made through **Tools > Preferences** (see [Changing user preferences on page 55](#)).

## Production Scenario Tab, Company-Defined Attributes

The mid-section of the first tab of the **Cost Guide** contains additional attribute fields.

**1.2 Company-Defined Attributes**

Description:

Product Line:

Model Number:

Project:

Revision:

Cost Type:

CAD Version:

GCD Extraction Time:

Purchased:

The specific attribute fields that are displayed are configurable and will vary from customer to customer. Your aPriori System Administrator may have created User Defined Attributes (UDAs – see the aPriori Professional System Administration Guide). By default, UDAs will appear in this section of the Cost Guide, but your System Administrator may have further configured the Cost Guide so such UDAs may appear anywhere. Attributes are used to describe the component and can be used when searching for a component, reporting on a component, and may even drive costing-logic for a component. Fields with an asterisk (\*) are required and must be provided before the component can be costed and saved.

**Note:** Your system administrator may have configured these fields and may have set them up so that they automatically get populated by properties or parameters that are defined in the CAD files. For more information on defining attribute fields to be used by your company, and how they appear in the aPriori user interface, see the sections on “User Defined Attributes”, “Dialog Views”, and “Using CAD Properties” in the *aPriori System Administration Guide*.

Here are some Company-Defined Attributes that are provided by default, and how they can be used:

- **Description** – Enter information that will help you identify the component.
- **Product Line** – Enter the product line on which the component is used.
- **Model Number** – Enter a unique identifying name or number for the component.
- **Project** – Enter the name of the project that includes the component.
- **Revision** – Enter the revision number for the component.
- **Cost Type** – Select the source that provided the cost information for the component.
- **CAD Version** – Displays the CAD version aPriori extracted from the component file.
- **GCD Extraction Time** – Displays the date and time the GCDs were last retrieved for the component. This information is provided by aPriori.

- **Purchased** – Check this box if you are purchasing this component from a supplier. Uncheck the box if you are making the component at one of your company’s factories.

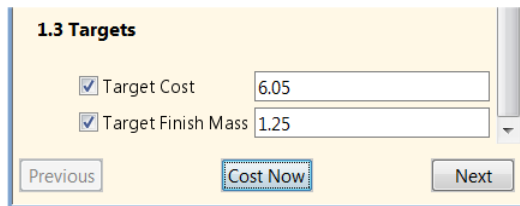
When you have completed entering information on this tab, you can either:

- Perform an initial costing by clicking the **Cost Now** button at the bottom of the **Cost Guide** (or the **Cost** button on the toolbar), or
- Proceed directly to the GCD Tolerances tab by clicking the **Next** button at the bottom of the **Cost Guide**, or by clicking the **GCD Tolerances** tab at the top of the **Cost Guide**.

Until you perform an initial costing, you will not be able to use the **Process and Machine Options** tab.

### Production Scenario Tab, Targets

The bottom section of the Cost Guide Production Scenario tab contains two important fields if you have specific goals regarding how much your finished part should cost or how much it should weigh.



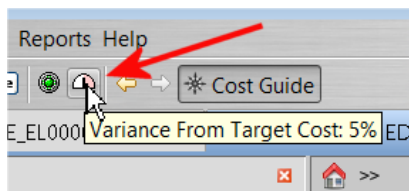
**Target Cost:** Specify a value in this field if you know how much you want or expect the fully burdened cost of the part to be and wish to compare it to the results of costing operations. aPriori provides two ways to easily compare this value against the value from a cost run:

- **Cost columns in the Part Details tab**

Cost Object			Fully Burdened	Aggrega...	Unit Cos...	Capital Costs	Cost Targets		
Status	Name	Scenario	Fully Burdened Cost (USD)	Batch Cost (USD)	Unit Cost - PPC (USD)	Total Capital Investments (USD)	Target Cost (USD)	Variance from Target Cost (USD)	% Variance From Target Cost
● *	Current	initial	6.38	2,920.06	5.40	26,767.82	6.05	0.33	5

**Note:** To display the Target Cost column, you may need to select **Part Details > Table View > Select Table View** and either **Cost Details** or **All Data**.

- **Cost Target icon**



Hovering over the **Cost Target** icon displays a tool tip containing the variance of the Fully Burdened Cost from the Target Cost. The color and position of the meter in the icon will vary depending on the size of that variance, as described in *aPriori Desktop icons and command buttons on page 61*.

**Target Finish Mass:** Specify a value in this field if you have a weight goal for your finished component. This is a common element of design, where you want your component to be as light as possible, and to use the least amount of material, while meeting performance and safety requirements. aPriori calculates the actual weight of the component, based on the volume of the CAD model and the density of the chosen material, and displays it alongside the **Target Finish Mass** value in the **Part Details** tab.

Cost Object			Component Mass			Mass Targets			Material Info
Status	Name	Scenario	Finish Mass (kg)	Scrap Mass (kg)	Rough Mass (kg)	Target Finish Mass (kg)	Variance From Target Finish Mass (kg)	% Variance From Target Finish Mass	Material Composition
● *	Current	initial	1.33	<0.01	1.33	▲ 1.25	▼ 0.08	▼ 6	Aluminum AL380

**Note:** To display the **Target Finish Mass** column, you may need to select **Part Details > Table View > Select Table View > All Data**.

## GCD Tolerances tab

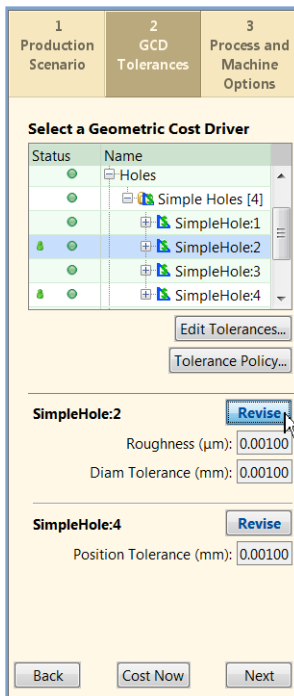
Status	Name	O... Name	Property Result
●	SimpleHole:1	Name	SimpleHole:4
●	Edge:13	Diameter (mm)	6.35
●	Edge:14	Hole Type	THROUGH
●	GCD Relations	Is Countersunk	false
●	SimpleHole:2	Is Flanged	true
●	SimpleHole:3	Blind	false
●	SimpleHole:4	Sleeve Pin Hole	false
●	Surfaces	Length (mm)	6.00
●	Other	Threaded	false
●	Edges [46]	Thread Length (...)	-
●	Edge:1	Roughness (µm)	<unspecified>

Use the GCD Tolerances tab to set either an overall tolerance policy for the component, or specific tolerance overrides for particular GCDs.

- To set a tolerance policy for the component overall, click the **Tolerance Policy...** button. (See [Using the Tolerance Policy Editor](#) for more information about the tolerance policy)
- To specify tolerance and roughness requirements for a GCD, first select the GCD and then click the **Edit Tolerances** button. See *Specifying or importing tolerance and roughness* on page 143 for more information.

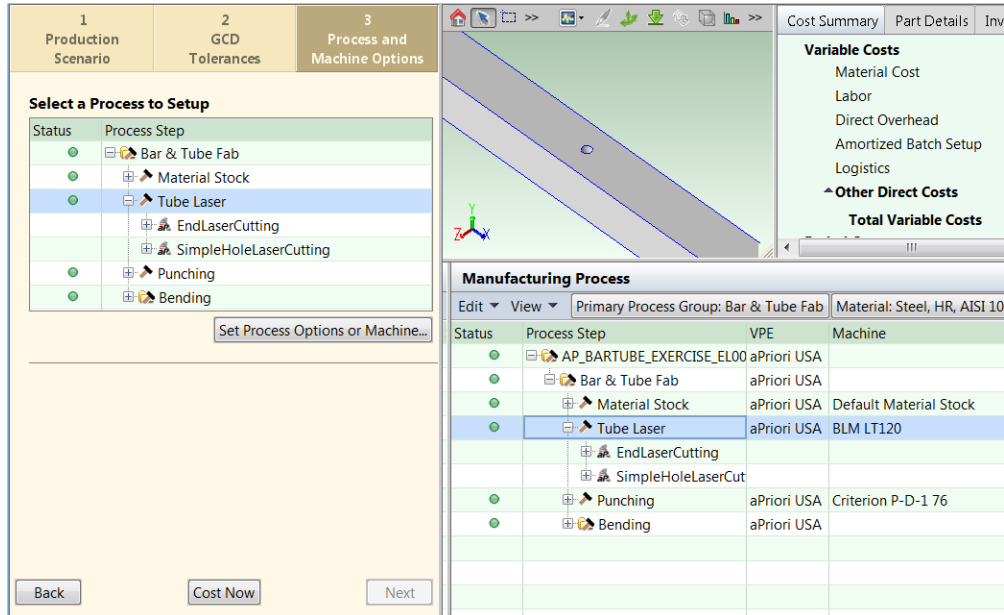
When using this **Cost Guide** tab, note that:

- The **Tolerance Policy** button is always enabled. The **Edit Tolerances** button is enabled when you have selected a GCD that can accept a tolerance setting.
- There is some interaction between the **Cost Guide** tab and the **Geometric Cost Drivers** panel. Depending on the object, selecting or acting upon something in one panel will be reflected in the other.
- For more GCD details, you can switch to the **Geometric Cost Drivers** panel and display the **GCD Properties** table to its right.
- When you edit the tolerance values for a GCD, each override is listed at the bottom of the **Cost Guide**, along with a **Revise** button.



When done with the **GCD Tolerances** tab, you may click the **Cost Now** button or move to another **Cost Guide** tab by clicking the **Next** button at the bottom of the **Cost Guide**, or by clicking the **Process and Machine Options** tab at the top of the **Cost Guide**.

## Process and Machine Options Tab



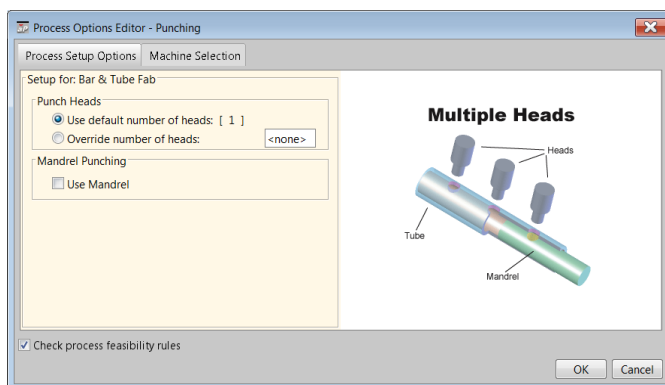
The **Process and Machine Options** tab lets you provide routing-specific inputs, such as selecting a specific machine or process setup options for processes included in the routing.

The top portion of this tab displays the selected routing in tree form, similar to the display in the **Manufacturing Process** pane. The tree displays processes chosen for the routing, and under each process specific operations that are used to manufacture specific GCDs.

If you have not yet costed the current component, this tab will display the message “**An initial cost must exist before you can override process-specific options.**” Ensure that your costing inputs are correct on the other two tabs, and then click the **Cost Now** button and return to this tab.

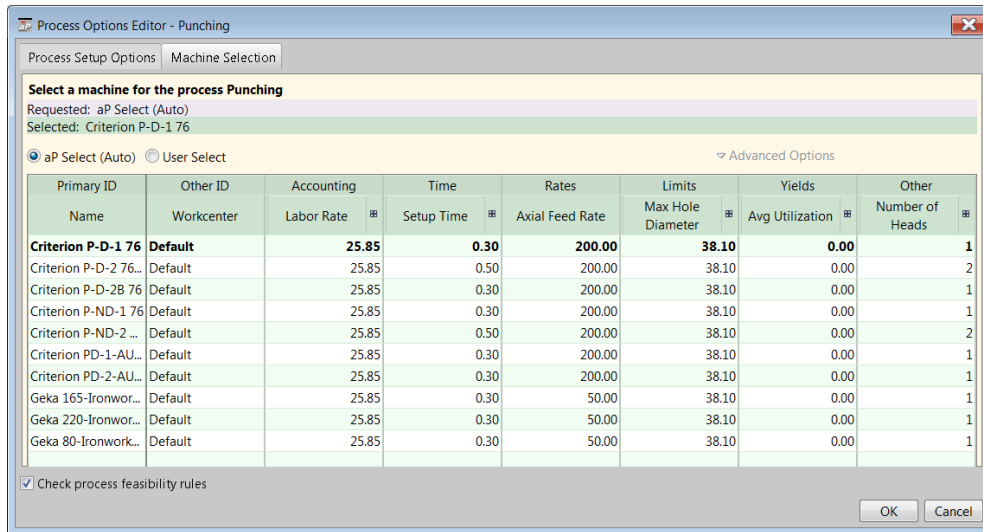
Depending on what you select in the process tree, the **Set Process Options or Machine...** button will display a window allowing you to specify a particular machine, or (if available) optional settings that can be modified for that machine, or both. If nothing can be user-modified for the selection, the **Set Process Options or Machine...** button remains disabled.

Here is the window that comes up when you select the Punching process for a Bar & Tube component:



The **Process Setup Options** tab displays any optional features that the currently selected machine allows you to configure. By default, aPriori checks feasibility rules to determine whether the current process should be costed with the current settings. If you wish to override this setting and ignore feasibility rules, unselect **Check process feasibility rules**.

You can select a different machine than the one that aPriori automatically selects by selecting the **Machine Selection** tab.



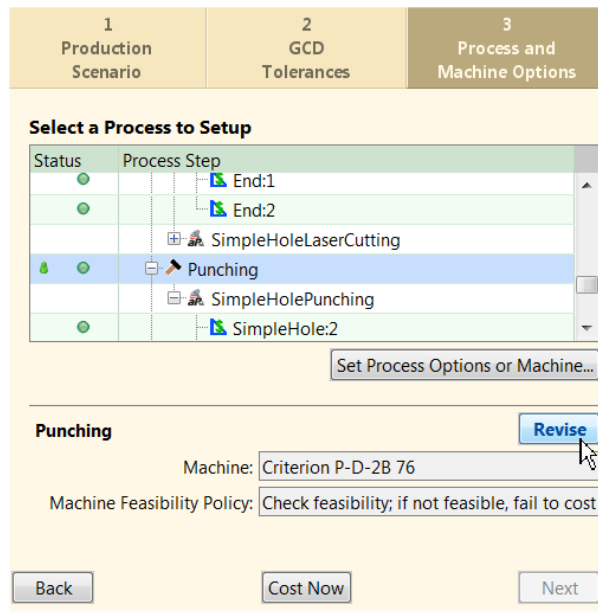
Selecting **Advanced Options** displays choices regarding whether or not to check the feasibility of that machine, and how to continue if aPriori determines that the machine cannot successfully handle the component. (The machine feasibility rules apply to the selected machine, while the feasibility checkbox at the bottom of the window applies to process feasibility rules.)

It is important to note that the **Machine Selection** and **Process Setup Options** tabs will differ significantly between different process groups and different VPEs.

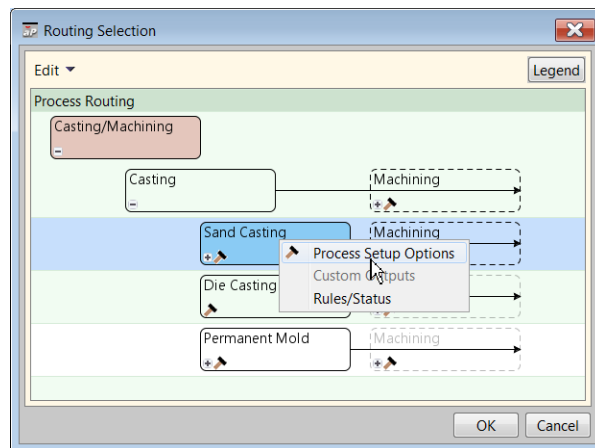
See [Selecting a machine for an operation on page 175](#), and [Editing process setup options on page 177](#), for more detailed information about how to specify machine and process overrides.

**Note:** In some cases, aPriori will display a **Process Setting Option** window that contains informational messages about values that aPriori has calculated for the selected GCD. These windows are read-only, so they are not actually PSOs that you can override.

As with the **GCD Tolerances** tab, any overrides that you specify will be listed at the bottom of the **Cost Guide** with **Revise** buttons to allow further modification.



**Note:** Although you typically do not specify Process Setting Options (PSOs) until after you have costed the component and proceed to the third tab, you can use a shortcut to specify PSOs before aPriori has even extracted GCDs. In the first tab, display the Routing Selection window and simply right-click a node. If any PSOs are available, the **Process Setting Options** menu item will be enabled. (The following example is from **Casting** process group.)



See [Selecting a process routing on page 182](#) for information about using this window.

## What you can do at different stages

Costing a component is not an all-or-nothing operation. You can do different things with a component at different stages of costing. Knowing this might save you time depending on what you need to accomplish.

When you first open a component, aPriori retrieves visualization information, displays the part in the component viewer, and displays the **Cost Guide**. At this point no GCDs have been extracted and no costing information has been processed. This stage is



useful for quickly opening a CAD file and visually inspecting its contents. Since no information has been processed, you cannot save the part at this stage.

As soon as you proceed to the second tab (see *GCD Tolerances tab* on page 30), the GCDs are extracted. At this stage, even though you have not yet costed the component, you can save it along with its automatically-generated thumbnail. This means that the component will now be viewable in search results, although its cost information will be blank or “0”.

The final stage is costed: the component will appear in search results, and cost fields will be populated with values based on the most recent cost operation.

## Costing with CAD Properties

Your aPriori system administrator may have configured your system to automatically extract properties or parameters from the CAD file and map those values to aPriori production inputs or User Defined Attributes (UDAs). If your CAD parts contain all the information that aPriori needs to successfully perform a costing (Process Group, VPE, Material, and Annual Volume), it is now possible to cost a part as soon as you open it, without the need for manually entering such information in aPriori. If you perform a role such as Design Engineer, this allows you to concentrate on part design and cost parts without worrying about production details that might be outside of your area of expertise.

**Note:** You should still review any automatically-populated inputs to ensure that they seem reasonable for the part you are costing.

This section concentrates on the production inputs that can be automatically mapped from CAD properties. Additional details and capabilities such as mapping to UDAs are discussed in the aPriori Professional *System Administration Guide*. The discussions in this section concentrate on the aPriori Professional user interface, but also apply to Bulk Costing (see [Bulk Costing and Analysis](#)).

If this feature is implemented for your installation, you should be aware of the following changes from an installation where automatic CAD property extraction is not implemented:

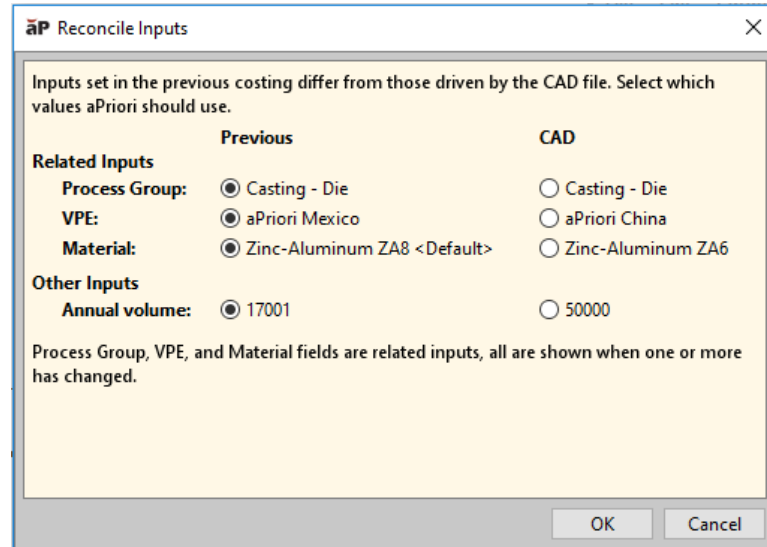
- Fields in the **Cost Guide** may be automatically set and updated without the need for you to manually enter values.
- Properties that change in the CAD file may cause a **Reconcile Inputs** window to pop up, to allow you to tell aPriori whether to accept the new values or continue to use previously-entered aPriori values. For more information, see [Reconcile Inputs](#) below.

When the values for aPriori fields are initially supplied from CAD properties, you can override those values in aPriori to explore the cost impact of different manufacturing scenarios. Once you override a production input that is mapped to a CAD property, your override value continues to be used for subsequent costings unless it is cleared. There are two ways to clear the override:

- By using the **Cost Overrides Summary** dialog (see [Working with the Overrides Summary dialog](#))
- By using the **Reconcile Inputs** dialog (see the following section).

## Reconcile Inputs

The **Reconcile Inputs** dialog informs you of CAD data changes that could significantly impact the aPriori cost estimate, and lets you determine how to proceed.

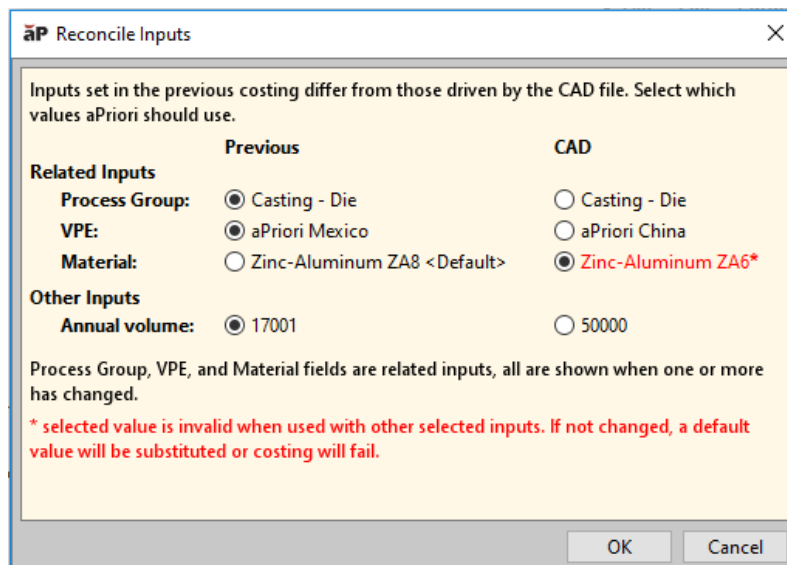


This window appears only when:

- A scenario already has been costed in aPriori.
- The values of one or more CAD properties that are mapped to production inputs subsequently change in the CAD file.

Rather than immediately changing the production inputs with the changed data and re-costing the scenario, the **Reconcile Inputs** dialog will display that the CAD field value that now disagrees with the previously-used value for that input. For each field that has changed, you can then decide whether to use the updated value from the CAD file or to continue using the previously-specified value.


The **Reconcile Inputs** dialog also provides some basic validation – it can tell you if you’ve selected an input which is not valid, either by itself or in the context of other selections. For example, in the following screenshot:

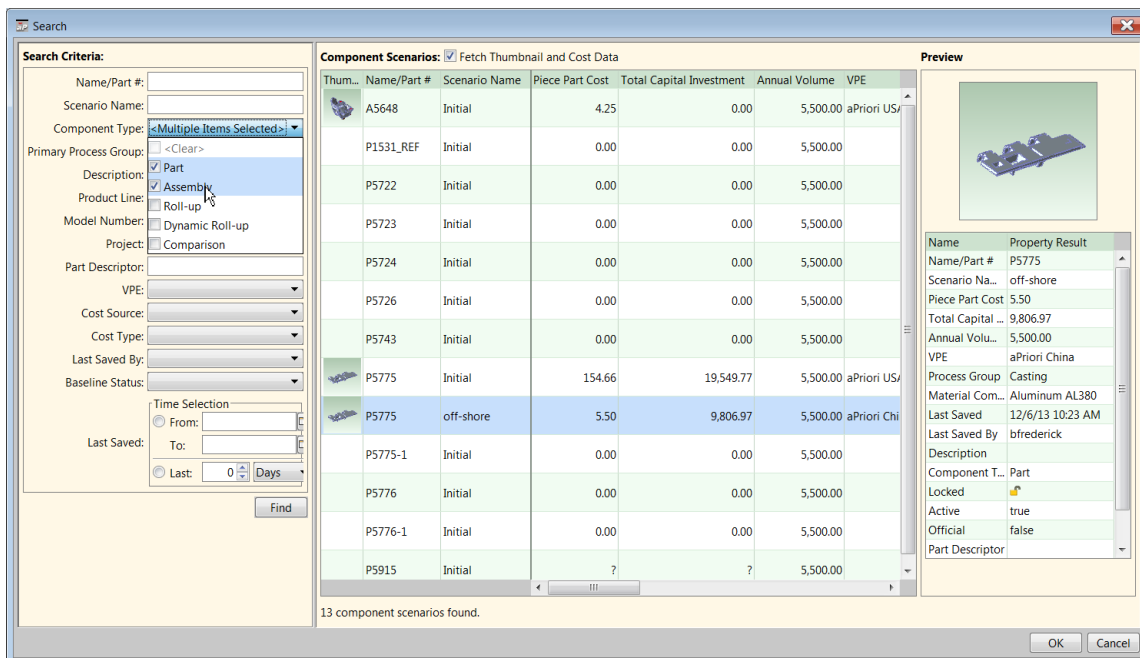


The CAD file had been updated to include a material “ZA6” which was not available in the selected VPE. (Or, if the CAD file had contained a VPE name which didn’t exist in your deployment, it also would be flagged as invalid.) This gives you the opportunity to change your selection. If you go ahead and click **OK** anyway when something is flagged as invalid, aPriori attempts to replace it with a default, or will fail to cost. Specifically, it will use a default Material from user preferences or from the VPE’s default material, and for other fields generally will fail to cost.

## Using the Search tool

Use the Search tool to find a cost component or group of components that meet specific criteria. The Search tool is available:

- From the **Search** toolbar button 
- When opening a cost component (select **File > Open**)
- When deleting cost components (select **Tools > Delete Components**)
- When adding cost components to a rollup (select **Edit > Add Component** from within the rollup)
- When copying cost settings (click the **Copy From** button in the Production Info or Cost Object window, or **Recently used settings > Choose another...** in the Cost Guide)



Use the Search Criteria panel on the left to display all matching components and their scenarios on the right. For example, to display all parts and assemblies, click the **Part** and **Assembly** checkboxes under Component Type then click **Find**.

**Note:** System Administrators can control several aspects of the Search tool. They can set a system variable to restrict the display of search results to only those components to which the user has access. (This applies only to sites that have

implemented Access Control.) They can also turn on and off the display of searchable attributes in the **Search Criteria** panel, including searchable User Defined Attributes (UDAs). Administrators can also rearrange the order of search attributes. What you see on this screen may differ from the screenshots shown in this section. For more information about access-restricted searches, User Defined Attributes, and customizing the Search Criteria panel, see the *aPriori System Administration Guide*.

You can combine any or all of these criteria to help you find cost components. If you do not wish to constrain your search by a given criteria, then leave that field blank. A

While most of the search criteria fields are specified using drop-down menus or calendar controls, some of the search criteria fields allow you to enter text into the search field. These include Name/Part #, Description, Part Descriptor (which maps to an internal CATIA V5 part name for SmarTeam, converted to lower case). You can use implied wildcards in these text fields. For example, if you type `abc` into the Name/Part # field, the Search tool will display all components with names containing the characters `abc`.

Note that the Search tool displays all scenarios for a specific cost component (assuming that you have access permissions to them). See *Working with initial scenarios* on page 70 for more information.

If your site implements Access Control and has set the system variable described above to display only results to which you have access, there may be a delay before you start to see results appear in the window. For example, if Search processes 10,000 scenarios before encountering one that passes the permissions check, it may be a while before you see the screen update with this result. The Search window now provides a Progress bar to inform you of how far the operation has proceeded through matching scenarios.

**Component Scenarios:** Searching...  49% complete

**Note:** You can cancel a search by closing the search window. You can also reset the existing search by choosing different criteria and clicking **Search** again.

## Changing the file associated with a component

Change the file association when the CAD file associated with a costed component has moved or if you want to associate the costed component with another file with the same name.

**Note:** The "CAD File Association" option is only available in standalone aPriori, not in direct integration mode.

### To change the file association

- 1 Save a scenario of the component to prevent data loss in case the file has significant geometry changes or was created in a different CAD system.  
For more information, see *Working with scenarios* on page 66.
- 2 Select **File > CAD File Association** to display the Select New File Association window.

- 3 Navigate to the file you want to associate and select it.

The file name must match the component name to change the file association. If the file name has changed, you must open a new component and copy the original cost settings instead. For more information, see *Copying cost settings from one component to another* on page 39.

- 4 Click **Open** to associate the selected file with the costed component.

## Copying cost settings from one component to another

Copy the cost settings from another costed component when you use aPriori to cost a part defined by a CAD file, then change the CAD filename. Copy the cost settings to avoid losing any costing changes you made when aPriori was referencing the previous file name.

You may also want to copy the cost settings from another component to speed costing for parts that are identical or highly similar to previously costed parts. For example, if a component changed a part name or number, copying the cost settings lets you avoid manually re-specifying all the cost inputs for that component.

You also have the option of copying either a single scenario or all scenarios from one component to another.

You can also copy some or all of the cost settings for an assembly to each of the assembly's children.

### To copy the cost settings from another costed component

- 1 Select **Edit > Production Info** from the Manufacturing Process pane to display the Production Info window.

You can also click **Copy From** on the Cost Object for an uncosted component. In an assembly, select an uncosted component in the component viewer or Geometric Cost Drivers pane, right-click it, and select **Initialize** from the context menu to display the Production Info window.

- 2 Click **Copy From** to display the Copy Component From Existing window.
- 3 Search for the donor component that contains the cost settings you want to copy. For more information, see *Using the Search tool* on page 37.

To copy all scenarios of the donor component, select only the component's entry in the Name/Part # column in the upper pane.

To copy a single scenario, after selecting the component in the upper pane, also select the desired scenario in the lower pane.

Components:				
Name/Part #	Component Type	Part Descriptor		P
AP_BRACKET_HANGER_EL0000	Part			S
AP_SHEETMETL_EXERCISE_EL0000	Part			S
FASTENER_EL0000	Part			S


  

Scenarios:				
Scenario Name	Component Type	Part Descriptor	Process Group	VF
brazil_at_12k	Part		Sheet Metal	aP
india_at_10k	Part		Sheet Metal	aP
Initial	Part		Sheet Metal	aP
usa_at_8k	Part		Sheet Metal	aP

Select only component to copy all scenarios.

Also select a scenario to copy only that scenario.

- Click **OK** to re-cost the recipient component using the cost settings copied from the donor component.

When you copy cost settings from another costed component, aPriori maps GCDs and GCD settings from the donor component to the recipient component. Any GCDs that aPriori cannot map to the recipient component's geometry are discarded. aPriori then creates new GCDs for recipient component geometry, as necessary. The GCD mapping works best for highly similar or identical parts, but we recommend that you confirm the correct mapping for all manually applied GCD settings by checking your green user  input indicators.

Copied information will include component-level settings (such as process group, annual volume, VPE, and manually selected routings) and GCD-level settings (such as tolerance and roughness settings or manually selected operation sequences).

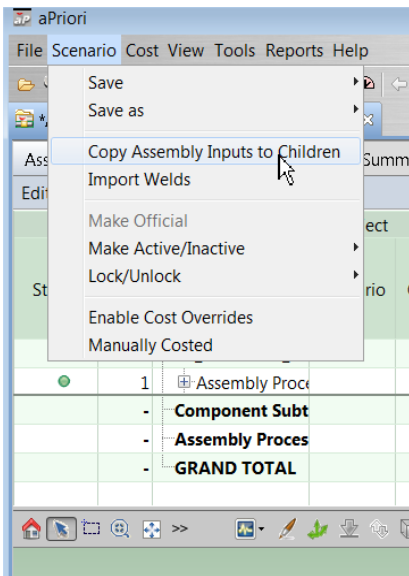
If the component in aPriori is not connected to a CAD file, aPriori will copy *all* the donor component settings into the recipient component, including the appearance of the donor component. Once you connect the recipient component to a CAD file, its GCDs will automatically update to match the CAD file's geometry.

## Copying assembly cost settings to children

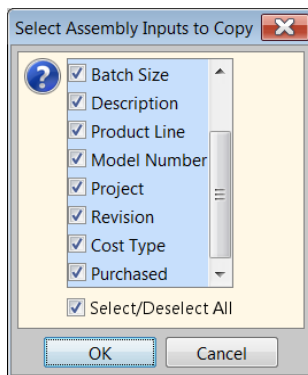
You can selectively copy the cost settings (including any user-defined attributes) applied to an assembly to the children of that assembly. **Note:** When Annual Volume and Batch Size values are copied to children, they are multiplied by the child quantity. Thus, if the assembly's annual volume is 10 and it has a child component that has a quantity of 5, then the child will get an annual volume of 50.

### To copy assembly cost settings to children

- Open an assembly.
- Select **Scenario > Copy assembly inputs to children**. (This is only visible for assemblies.)



- 3 Use the checkboxes in the resulting Select Assembly Inputs to Copy dialog to specify which values to copy. If you have user-defined attributes, use the scroll bar to view them at the bottom of the list. Click **OK** when done.



## Using the Cost Object Info window

The **Cost Object Info** window contains many of the same fields as the **Cost Guide** (see *Initial costing: the Cost Guide on page 21*), and can be used to change settings for your component. aPriori displays the **Cost Object Info** window when you click **Edit > Production Info**, **Edit > Administrative Info**, or **Edit > Quoted Cost** from the **Manufacturing Process** panel.

**Note:** Your aPriori System Administrator may have customized the Cost Object Info tabs so that the displayed fields reflect your company's standards and workflows. This section describes how this Cost Object Info tabs appear out of the box and may differ from what you see on your screen. For more information, see the "Managing Dialog Views" section of the aPriori Professional System Administration Guide.

## The Production Info tab

The screenshot shows the 'Cost Object Info' dialog box with the 'Production Info' tab selected. The 'Part Number' is 'ap\_sheetmetal\_exercise\_EL0000'. The 'Process Group' is set to 'Sheet Metal'. The 'VPE' is 'aPriori USA'. The 'Material' is 'Steel- CR- 1020'. The 'Annual Volume' is '5,500' and the 'Production Life' is '5.00'. The 'Costing Method' is 'aPriori' with a currency of 'USD'. The 'Batch Size' is 'Auto (458)'. There are checkboxes for 'Target Cost' and 'Target Finish Mass', both of which are currently unchecked. A 'Copy From...' button is located at the bottom right of the form area. At the bottom of the dialog are 'OK', 'Cancel', and 'Apply' buttons.

You can specify the following information on the **Production Info** tab:

- Select the process group from the **Process Group** drop-down list to make that group the default for subsequent new components.
- If you need to modify the default VPE, click  next to the **VPE** field to display the **Virtual Production Environment Selection** window.  
The default VPE is specified by the selected process group.
- Check the **Use as default VPE for secondary processes** box if you want secondary processes, such as heat treatments and surface treatments, to always use the same VPE as the primary process group, even if the VPE is changed.

If the secondary processes are frequently performed at a different location than the primary processes, uncheck this box.

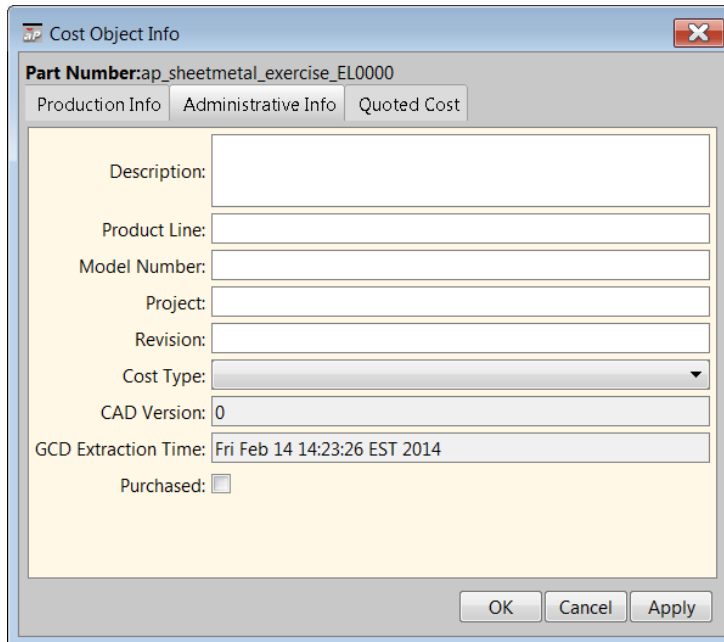
- If you need to modify the default material, click  next to the **Material** field to display the **Material Selection** window.  
The default material is either the MCAD material value or the VPE default.
- Enter the number of parts to be produced in one year in the **Annual Volume** field.
- Enter the length of the product life cycle, in years, in the **Production Life** field.
- Select the costing method. Select **aPriori** if you want aPriori to compute the component cost. Select **Manual** and select the currency from the drop-down list to enter the component cost.
- Select the batch size. This is typically one month's production. Select **aPriori** to have this automatically calculated from your **Annual Volume/12**. Select **Manual** to enter a specific value.



- Specify a value in the **Target Cost** field if you know how much you want or expect the fully burdened cost of the part to be and wish to compare it to the results of costing operations. (See *Production Scenario Tab, Targets* on page 29 for more details about how to use this value.)
- Specify a value in the Target Finished Mass field if you have a weight goal for your finished component. (See *Production Scenario Tab, Targets* on page 29 for more details about how to use this value.)

## The Administrative Info Tab

Use this tab to enter company attribute information about the component.



The screenshot shows a dialog box titled "Cost Object Info" with a close button (X) in the top right corner. The "Part Number" is "ap\_sheetmetal\_exercise\_EL0000". There are three tabs: "Production Info", "Administrative Info" (which is selected), and "Quoted Cost". The "Administrative Info" tab contains the following fields:

- Description: [Text Field]
- Product Line: [Text Field]
- Model Number: [Text Field]
- Project: [Text Field]
- Revision: [Text Field]
- Cost Type: [Dropdown Menu]
- CAD Version: 0 [Text Field]
- GCD Extraction Time: Fri Feb 14 14:23:26 EST 2014 [Text Field]
- Purchased:


At the bottom of the dialog box are three buttons: "OK", "Cancel", and "Apply".

See *Production Scenario Tab, Company-Defined Attributes* on page 27 for more information about the fields on this tab.

## The Quoted Cost Tab

Use the fields on this tab to enter information that is used in cost per mass analyses and to compare it to the aPriori cost estimate. It can also be used in reports.

The following fields are available:

- **Factory (Source)** – Enter the factory or source for the quoted cost information.
- **Material Composition** – Enter the material used to create the quoted cost.
- **Process Routing** – Enter the process used to create the quoted cost.
- **Total Cost** – Enter the total quoted cost to manufacture the component.
- **Total Capital Investments** – Enter the total quoted capital investment cost to manufacture the component.
- **Currency** – Select the currency used for the quoted costs.
- **Annual Volume** – Enter the quoted number of components to be produced per year.
- **Quoted Date** – Click  and select the date of the quote.

## Notes about purchased parts

You can specify that a component is a purchased part in several places within aPriori, including the **Purchased** checkbox in the **Administrative Info** areas of the Cost Object Info dialog, the **Cost Guide**, and the Bulk Loader, as well as the mapped **Purchased** field in the BOM Loader. Parts designated as "purchased parts" will be reflected as material costs for the assemblies in which they are included. This means the cost breakdown will match typical customer cost accounting practices. The full detailed cost breakdown for the purchased part still can be viewed by opening the individual component. In aPriori releases earlier the 2014 R1, the behavior of this feature could differ depending upon where it was set, but now the behavior is standardized throughout the product. For purchased parts:

- material cost = piece part cost (PPC)


- all costs which are used for PPC calculation except % margin are zeroed out, but only for the component level
- fully burdened cost = piece part cost + total amortized investment
- rolling up costs is only available if a purchased component is inside an assembly or any other container. Otherwise it is a regular part/assembly.

**Note:** In aPriori Release 2015 R1, the BOM Loader re-introduced the option of aggregating purchased part costs through a new checkbox. By default, the BOM Loader simply maps the **Purchased Flag** column to the **Purchased Part** checkbox specified in **Administrative Info**.

## Subsequent costing and costing with scenarios

When you open a component that has been costed before, aPriori Desktop displays the saved cost information for the component on the **Cost Object** window. To display this window or edit production, administrative, or quote information, select **Production Info**, **Administrative Info**, or **Quoted Cost** from the **Edit** menu on the **Manufacturing Process** panel.

aPriori provides several ways to update costing as a component changes:

- auto-costing – Depending on a number of factors and settings described below, aPriori can sense when an object's CAD information has changed and automatically recost the component
- **Cost** buttons () – aPriori provides Cost buttons at various places throughout the interface. Click this button when you want to manually initiate a costing operation.
- The **Cost** menu – This menu exists in the aPriori menu bar and provides advanced costing options such as costing multiple component scenarios and “deep” costing of children components within assemblies.

You can define different scenarios for parts, assemblies, cost comparisons, and roll-ups, and explore the impact of different inputs on the cost of a component. A part or assembly's initial scenario is the *official scenario* by default. You can specify another scenario to be official. The *official scenario* is the default scenario to roll into an assembly depending on the setting of the **Tools > User Preferences > Use Official Scenarios in New Assemblies**, and if a specific scenario is not otherwise specified. This is the one that is costed when you perform a “deep cost” operation (**Cost> Deep Cost Scenario & Children**). This allows you to select a specific component scenario to roll into an assembly or to use the designated official scenario in a specific assembly. In the latter case, changing which scenario of a component is designated as official will result in changing which scenario rolls into the assembly. Only one component scenario may be designated "Official". You can use the right-click **Switch Scenario** feature in the **Assembly Details** view to choose another scenario for child components other than the official one. (Note that subcomponents must be initialized before you can switch scenarios.) You can cost all child scenarios, both official and non-official, by clicking **Cost> Deep Cost All Scenarios**. See *Working with scenarios* on page 66 for more information.

**Note:** When you specify that the official scenario of a sub-component is to be used, the **Assembly Details** display will show that component with parentheses around the

scenario name. In the following screenshot, both AP\_SHEETMTL\_EXERCISE\_EL0000 (which has a new scenario that is official) and WELD\_SUPPORT\_EL0000 (whose original "initial" scenario is official) have been specified to use their official scenarios.

Assembly Details				
Assembly Tracker				
Cost Summary				
Edit Table View Options				
Cost Object				
Status	Level	Name	Scenario	Quantity
● *	0	AP_ASSEMBLY_EXERCISE_EL0000	initial	1
●	1	Assembly Processes		
●	1	AP_SHEETMTL_EXERCISE_EL0000	(hi_volume)	1
●	1	AP_BRACKET_HANGER_EL0000	initial	1
●	1	WELD_SUPPORT_EL0000	(initial)	1
●	1	FASTENER_EL0000	initial	1

Unless a scenario has been set to "Inactive", CAD changes to a CAD-connected part will be automatically picked up when the scenario is costed. However, if no CAD changes have occurred since the last costing, aPriori will not refresh GCDs in subsequent costings, even if the component is CAD-connected and set to "active". To refresh GCDs for an inactive scenario you can either:

- Click the **Refresh GCDs** button (🔄) on the aPriori toolbar.
- Select **Refresh GCDs from CAD Model** from the right-click context menu in the **Navigation** pane.

### Subsequent costing in CAD Independent mode if the component is file-connected

aPriori checks the CAD-file for GCD changes done since the current cost was saved. aPriori can only detect the changes that have been saved into the CAD-file.

If aPriori detects no changes in the CAD file, the current costing information is displayed. The 🔄 icon in the Cost Outputs pane indicates that the cost is current.

If aPriori detects changes in the CAD file and if the scenario is not specified to be "Inactive" and One Click Costing™ is:

- **Off:** aPriori immediately costs the component and displays the new cost information. (Disabling One Click Costing is the same as enabling auto-costing.)
- **On:** aPriori displays the existing cost information, but the Cost Outputs pane is disabled and the 🛑 icon indicates that the cost is not current. Click **Cost** to cost the component.


To cost an inactive scenario based on the most up-to-date CAD changes, you must click 🔄 in the aPriori toolbar to refresh GCDs. (But you can always cost an inactive scenario with the existing GCD data.)



## Subsequent costing in CAD Independent mode if the component is file-disconnected


aPriori has no way to detect GCD changes. The cost information is displayed as current. You are not allowed to perform any operations that require regenerating GCDs.

## Subsequent costing in Direct Integration mode

aPriori checks the CAD system for GCD changes done since the current cost was saved.

If aPriori detects no GCD changes, the current costing information is displayed. The  icon in the Cost Outputs pane indicates that the cost is current.

If aPriori detects GCD changes and if the scenario is not specified to be “Inactive”, then aPriori displays the existing cost information, but the Cost Outputs pane is disabled and the  icon indicates that the cost is not current. Click  to cost the component.

To cost an inactive scenario based on the most up-to-date CAD changes, you must click  in the aPriori toolbar to refresh GCDs. (But you can always cost an inactive scenario with the existing GCD data.)

## Using the Cost menu

The **Cost** menu is useful for costing parts with multiple scenarios and assemblies with multiple sub-components and multiple scenarios. The options on the **Cost** menu invoke the same interface as the separately-licensed Bulk Costing and Analysis utility, but the features available from the **Cost** menu do not require a separate license.

Here is a summary of the options on the **Cost** menu:

### **Cost**>

**Cost Scenario** – Cost just the current scenario for the selected component.

**Cost All Scenarios** – Cost all scenarios for the selected component.

**Deep Cost Scenario** – (Assemblies, Roll-ups, and Cost Comparisons only.)

Cost the current scenario for the selected component, and the scenarios of all of its children.

**Deep Cost All Scenarios** – (Assemblies, Roll-ups, and Cost Comparisons only.)

Cost all of the scenarios for the selected component, and all of their children.

Note that when you perform a deep cost, aPriori will check all of the sub-components to see if any are open in the main UI with unsaved changes. If so, aPriori will prompt whether you want to save and close that component, leave it unsaved, or cancel the deep cost operation. It is important to realize that regardless of what you choose, the results of the deep cost will be determined by the inputs on the Bulk Costing and Analysis table, or any user inputs file, not by the changes to the sub-component in the UI.

When deep costing assemblies, note that:

- If a sub-component (scenario) with unsaved changes is open in the main UI, aPriori copies the sub-component scenario to the Bulk Cost Group. If a sub-component is not open in the main UI, the component state is read from the database.

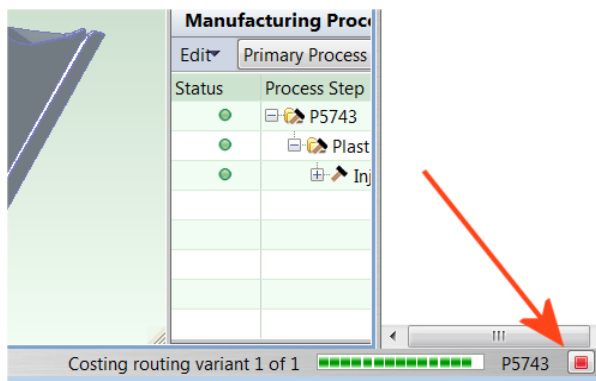
- If a sub-component does not exist in the database (and therefore cannot be opened), a new component scenario is created with default values. However, the component must be associated with a CAD file (unless the component is being costed in the User Guided process group). If an assembly has been initialized, the immediate sub-components are automatically associated with CAD files even if they have not been initialized. For deeper level children, aPriori assumes that those sub-component CAD files are located in the same directory as the root assembly. If that is not the case, you must ensure they are CAD-file associated prior to clicking on **Deep Cost** menu

When you deep cost an assembly and view the Bulk Costing & Analysis UI, the scenario of the top-level assembly is the same as the one you selected in the main aPriori UI. The sub-components are set to whatever scenarios are associated with this assembly – this may have been switched by the user in the UI or may have been specified during BOM loading. If nothing else has been specified, the Official scenario is the default.

**Note:** You can deep cost a roll-up or a cost comparison with **Cost-> Deep Cost Scenario**, but only their sub-components will appear in the Bulk Cost Group. The roll-up or cost comparison themselves do not associate with any cost and therefore will not be costed. However, if a roll-up contains a sub-roll-up, then the components from that sub-roll-up are also included in the costing.

## To cancel a costing operation

Once aPriori begins a costing operation, you can cancel it if a **Cancel** icon appears in the lower-right corner of the window:



It is not always possible to cancel a costing operation. For example, the **Cancel** icon is not available from the **Bulk Costing & Analysis** window.

When aPriori cancels a costing operation, note that:

- The cancellation affects only costing; it does not affect GCD extraction. If you click the **Cancel** icon during GCD extraction, nothing will get cancelled until the GCD extraction is complete.
- No routing is selected. (I.e., aPriori does not just pick the best routing up until that point).
- The **Manufacturing Process** window displays information similar to what is shown when an error occurs during costing: aPriori displays red Xs as necessary with tool-tip text that reads “Costing Cancelled – previous manufacturing info shown”.

Status	Process Step	VPE	Machine
✘	P5743	aPriori USA	
✘	Plastic Molding	aPriori USA	
			Macron: 225

- In the **Cost Summary** tab, the information in the **Current** column moves to the **Previous** column and the **Current** column remains blank. Note that if you cancel two times in a row, the **Previous** column is not updated to blanks. Again, this behavior is similar to what happens when a costing error occurs: the **Previous** column simply displays the last successful, fully-costed results.
- The **Cancel** icon works on a per-costing basis: whatever part is being costed when **Cancel** is clicked is what gets canceled, nothing more. If you are in an assembly and select multiple subcomponents that are uninitialized and select initialize, cancelling affects whichever part is currently being costed. aPriori then moves on to the next part and starts costing that one. The **Cancel** icon will not cancel all parts that are currently queued up for costing.

## More About Costing

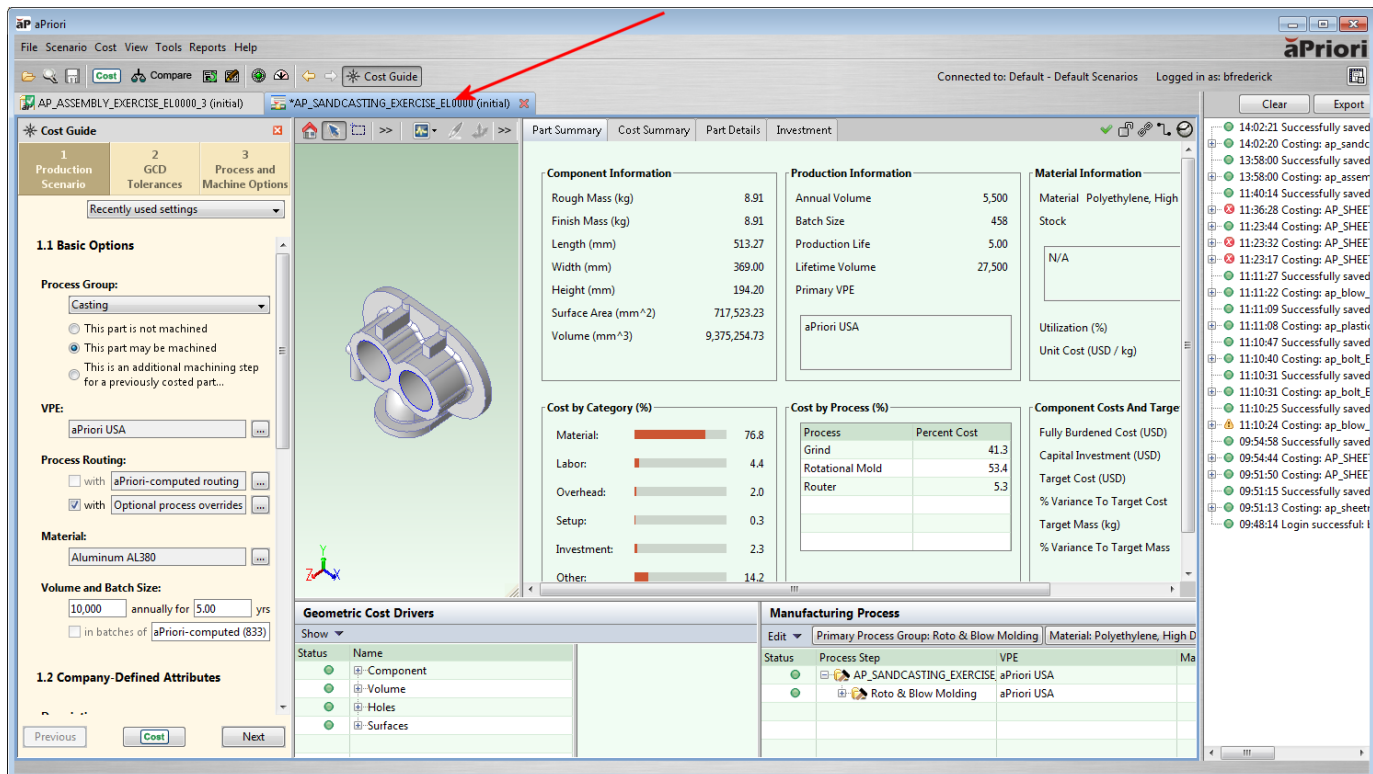
This section has introduced only the basics about costing. With aPriori, you can perform sophisticated costing operations with different scenarios, and by controlling factors such as whether to cost just at the top level of an assembly, or to “deep cost” all of the assembly’s children parts, and their scenarios. You can also apply some or all of an assembly’s production input values to its children, using a single command.

For more information, see *Using the Scenario Menu* on page 67 and *Bulk Costing and Analysis* on page 280.

## Component scenario tabs

In aPriori Desktop, every component scenario is displayed in a separate tab. (For information about scenarios, see *Working with scenarios* on page 66.) To switch from one scenario to another, click on the corresponding tab.

**Note** In Direct Integration mode, you can also switch to a specific MCAD component scenario by activating that component in the CAD tool.



An asterisk next to the component name on the tab label indicates that the scenario has been edited but not saved since the last time it was retrieved from the database. If no asterisk is shown, all edits have been saved.

A part or an assembly scenario tab includes the following:

- Component Viewer
- Cost Outputs
- Manufacturing Process
- Geometric Cost Drivers

For a part, the Cost Outputs section includes tabs for **Part Summary**, **Design to Cost**, **Cost Summary**, **Part Details**, and **Investment**, which are discussed in Chapter 9, *aPriori Cost Tables*. Assemblies do not have a **Cost Summary** tab, and have an **Assembly Details** tab instead of a **Part Details** tab.








### To change the component scenario tab layout

- 1 Select **View > Change Layout**.
- 2 Select one of the five available layouts.
- 3 To make the selected layout the default choice for part or assembly, select: **View > Use as Part Default Layout** or **View > Use as Assembly Default Layout**.



## Component Viewer

The Component Viewer provides a three-dimensional image of a part or an assembly. The image is automatically saved to the database and is available whenever the part or assembly is opened.

Icon	Function	Usage
	Reset	Click this icon to reset the image to its original state.
	Select	<p>Click this icon, then click anywhere on the image to select a specific Geometric Cost Driver (GCD). The selected GCD is highlighted in the Geometric Cost Drivers table and information related to this GCD is displayed.</p> <p>To select multiple GCDs of the same type, for example, multiple holes or welds, press the <b>Ctrl</b> key and click GCDs one by one.</p> <p>To deselect a selected GCD, press the <b>Ctrl</b> key and click the selected GCD.</p>
	Marquee Selection	Use this tool to draw a box on the screen and select all GCDs within that box of the same type. Choose from: Bending/Forming, Volume, Holes, Surfaces, Joining, Other, Not Supported
	Zoom	<p>To zoom in, click this icon, press the left mouse button and move the mouse toward you.</p> <p>To zoom out, click this icon, press the left mouse button and move the mouse away from you.</p> <p>Alternatively, move the middle mouse button wheel forwards and backwards to zoom in and out.</p>
	Pan	<p>To move to a certain part of an image, click this icon, press the left mouse button, then move the image by moving the mouse.</p> <p>Alternatively, press the Shift key and the middle mouse button to move the image.</p> <p>Panning is especially useful when the image is zoomed out so that it does not fit into the Component Viewer.</p>
	Rotate	To rotate an image, click this icon, press the left mouse button, and move the mouse. Alternatively, press the middle mouse button and move the mouse
	Render mode	To change the way the image is displayed, click this icon and select <b>Solid</b> , <b>Wireframe</b> , <b>Transparent</b> .

The viewer also provides the following shortcuts when you click on the origin symbol in the lower left of the view:

- Click on the origin: Reset. The part will snap to standard orientation, based on the position of the cursor relative to the axes on the origin. Continuing to click will toggle between different axes.
- Click and hold on the origin: Rotate. The part will rotate about its centerpoint (as opposed to the Rotate operation described in the table above, which causes the part to rotate in relation to the position of the cursor).
- CTRL-click and hold on the origin: Zoom.
- SHIFT-click and hold on the origin: Pan.

The Component Viewer also provides a number of tools and commands for displaying and editing Geometric Cost Drivers for the current part or assembly. For more information see *Using the component viewer tools and commands* on page 78.

You can import bills of materials into aPriori using the BOM Loader in the VPE Toolset. For more information, see *Importing* on page 78.



### To change the size of the Component Viewer

Click the right bottom corner of the component viewer and drag it with your mouse cursor.

## Cost outputs

The Cost Output pane displays various views of cost information depending on the type of the current component.

The clock icon indicates whether the displayed cost outputs are current:

- The Current icon  indicates that the component has not been modified since this cost was calculated.
- The Stale icon  indicates that the component has been modified since this cost was calculated.

Place the mouse pointer over this icon to see when the displayed cost was saved.

### To change the display currency

The default display currency is USD. You can create a list of available currencies in aPriori Administrator and use this list to change the display currency in aPriori Desktop.

- 1 Select **View** > **Change Currency**. The Select Currency window is displayed.
- 2 Select the currency from the **Currency** drop-down list.
- 3 Select the version (if any) from the **Version** drop-down list.
- 4 Click **OK**.

For information about creating the list of available currencies and saving currency exchange rate versions, see the aPriori *VPE Administration Guide*.

If currency conversion is required based on the default currency and the display currency, the value is displayed in italics. To see the conversion rate, place the mouse pointer over a value.

**Note:** You can also change the displayed currency from the **Cost Guide** IF the selected **Process Group** is set to **Manually Costed**. (The currency field is not deployed on the **Cost Guide** for any other process group.)

## Manufacturing process


The Manufacturing Process pane shows information about the manufacturing processes available for each component and provides tools to edit the current manufacturing process. For details, refer to *Manufacturing Process Information* on page 134.

## Geometric cost drivers

The Geometric Cost Drivers (GCDs) pane shows information about the GCDs available for each component and provides tools to edit current GCDs. For more information, refer to *Geometric Cost Drivers* on page 198.

You can display GCD labels for the highlighted GCDs in the Component Viewer. In Direct Integration mode, you can also display GCD labels in the CAD application.

### To show GCD labels in the component viewer

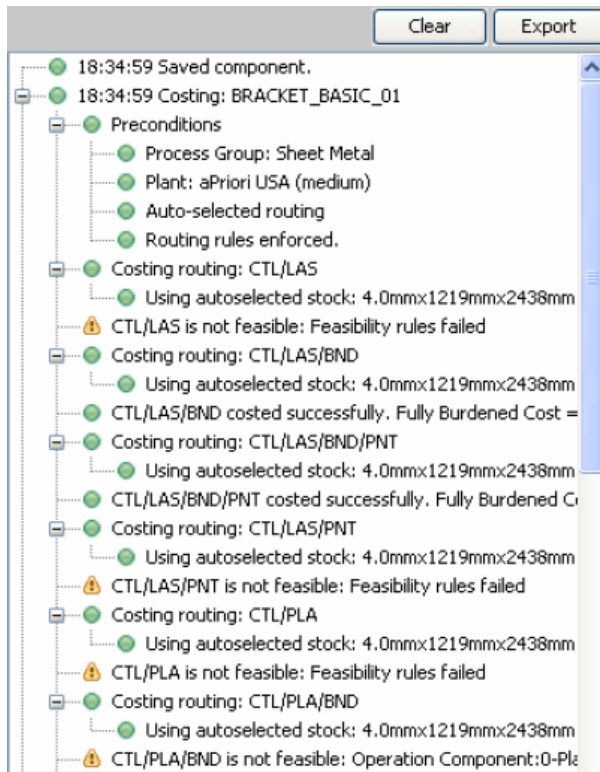
- 1 Click the Analysis button  in the Component Viewer tool bar.
- 2 Select Show GCD Labels.
- 3 Click on a GCD in the GCD pane. In the Component Viewer, the GCD is highlighted and the GCD label is displayed.

### To show GCD labels in the CAD application

- 1 In your CAD application, select aPriori > **Show GCD labels**.
- 2 In the aPriori Desktop, click on a GCD in the **GCD** pane. You can see the GCD label for this GCD in the CAD application.

## Status messages

Status messages provide detailed information about the state of the aPriori system, especially cost estimation calculations. Any warnings or errors that occur during costing are displayed as status messages.



### To view / hide messages

Select / deselect **View > Show Messages** or click the  button.

### To clear all messages

Click the **Clear** button in the messages pane.

### To export messages into a file

- 1 Click the **Export** button in the messages pane. The Export Messages to a File window displays.
- 2 Select the folder where you want to save the file.
- 3 Enter a name for the file.
- 4 Click **Save**.

## Saving cost information

At any time during the costing process, you can save the current cost information for a component. After saving the cost information, you see the current cost information displayed in the Last Saved column.

**Note** If you try to close a component without saving, aPriori prompts you to save the component. If you do not save the component, you will lose the unsaved changes.

### To save current cost information for a component

Click the  button or select **Scenario > Save > Scenario**.

You can also use the following keyboard shortcut:

Ctrl-s

(For more information about aPriori scenarios and additional Save options, see *Working with scenarios* on page 66 and *Using the Scenario Menu* on page 67.)

## Refreshing the database connection

At any time during the costing process, you can refresh aPriori Desktop with information stored in the database. When you refresh the database connection, you lose all unsaved changes.

### To refresh the database connection

- 1 Select **File > Refresh Database Connection**. A window prompting you to confirm the refresh from the database is displayed.
- 2 Click **Yes**.

**Note:** This is an important step for VPE Administrators when importing VPE data using the command line. If you have completed such an import of VPE data and the VPE data appears to have remained the same, close the VPE and click **File > Refresh Database Connection** to see the new data.

## Changing user preferences

aPriori User Preferences control various aspects of startup and costing behavior for both aPriori Desktop and the Cost Ticker. You can edit user preferences only in aPriori Desktop.

You can set the following preferences by selecting from the **Tools > User Preferences** menu:

- Start aPriori with CAD application
- One Click Costing™ (enabling/disabling auto-costing in response to CAD changes)
- Default Production Inputs
- Cache New VPEs on Start-up
- Default Scenario Name
- Viewer
- Use Official Scenarios in New Assemblies

You can also select **View > Show English Units** from the aPriori menu to display units in English units instead of system (metric) units.

Once you have specified a user preference, it is “remembered” and subsequently takes effect each time you run aPriori. You may change user preference settings at any time.

## Start aPriori with CAD application

Select **Tools > User Preferences > Start aPriori with CAD Application**. By default, this preference is enabled (checked), which means that aPriori starts automatically when the CAD application is started (Pro/ENGINEER direct integration only). Uncheck this option to disable automatic startup of aPriori.

## One Click Costing™ (enabling/disabling auto-costing in response to CAD changes)

One Click Costing is the opposite of auto-costing: Auto costing means that aPriori automatically re-costs a component in response to each CAD change, such as adding or modifying a CAD feature, regenerating a component, or activating a window/component. One Click Costing, in contrast, requires that you click the **Cost** button to explicitly kick off a costing operation. If you make frequent design and cost estimate iterations and do not wish aPriori to automatically cost every time the CAD model changes, you should ensure that the One Click Costing™ preference is enabled.

Select **Tools > User Preferences > One Click Costing™**. By default, this preference is enabled (checked).

**Note:** In releases of aPriori prior to 2014 R1, One Click Costing was disabled by default (i.e., auto costing was enabled by default). Also, in earlier releases of aPriori, entering a Cost Override would cause the component to recost, even if One Click Costing was enabled. Now multiple Cost Overrides can be entered without re-costing until you explicitly click a **Cost** button. See *Overriding computed values* for more information.

## Default Production Inputs

Select **Tools > User Preferences > Default Production Inputs...**. The **Default Production Inputs** window appears. This window allows you to specify personalized default values for Production Info settings, including the default Process Group, VPE, Material, Annual Volume, Production Life, and Batch Size fields. Once you have specified your personalized default values, when costing a new component, the **Cost Object Window** and **Cost Guide** will be pre-populated using the specified defaults.

This preference enables you to set defaults that are relevant to the types of parts or projects you are working on. They can be changed at any time. User-level production input preferences will take precedence over any site-wide defaults; if no user-level production inputs are specified, then the site-wide defaults will be applied. For more information on Production Inputs see *Initial costing: the Cost Guide on page 21* and *Using the Cost Object Info window on page 41*.

## Cache New VPEs on Start-up

By default, upon client start-up aPriori creates a local (or shared) cache of all VPEs. This process may take up to several minutes, depending on factors such as network speed

and the number and complexity of VPEs at your site. Subsequent start-ups simply update the cache and are typically much faster than the initial cache.

Unchecking this preference causes aPriori to revert to older caching behavior, which does not retrieve and cache VPE data until you cost a part using that VPE. This older behavior sometimes introduces significant delays during the costing process, and also does not display progress messages like the newer, default behavior.

**Note:** See the *aPriori System Administration Guide* for information about options to clean caches.

## Default Scenario Name

By default, when you open a component in aPriori and perform the initial costing, an initial cost scenario for the component is created with the name "Initial". Use this preference to change the name that aPriori uses for initial scenarios.

## Viewer

By default, aPriori uses an Open GL graphics driver to render the cost component in the Viewer pane. Most users should have no need to change the graphics driver setting. If you are experiencing display issues (such as an image of the part that appears to be incomplete, with missing or extra triangles displayed on the window), then it may be resolved by specifying a different graphics driver.

To change the graphics driver used by aPriori, select **Tools > User Preferences > Viewer** and then select from among the supported drivers. Please contact aPriori Support if you continue to experience display issues or instability.

## Use Official Scenarios in New Assemblies

Use this setting to determine which scenario gets included when a new assembly is created, or when a new part is added to an existing assembly. This can be useful to handle situations such as catalog parts which have a consistent standard list price, even when included in different assembly scenarios representing different production conditions. This preference provides the following settings:

- **Always:** The Official scenario of the child will be used unconditionally.
- **When Component Exists But No Matching Scenario:** The Official scenario of the child will be used only when the child component exists but does not have a scenario that matches the assembly.
- **Never:** A new scenario matching the assembly scenario will be created and rolled into the assembly.

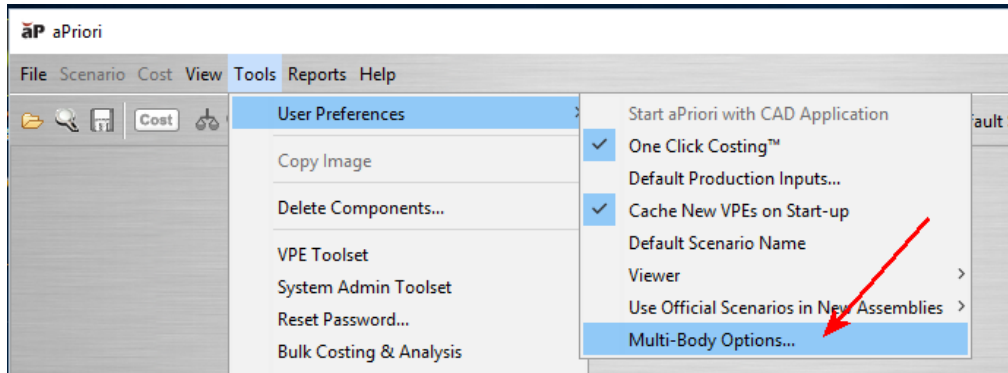
The default is **Never**.

**Note:** If you used the older "true/false" preference in a version prior to 2015 R1, you must re-select this option since this preference now has three states. If you have never used this preference before, you should review your current Catalog Parts workflows with your aPriori Account Team or aPriori Support to determine how best to leverage this functionality.

## Multi-Body Options

As of release 2019 R1, aPriori Professional provides a preference setting for Multi-Body Options. This enables you to specify how aPriori should interpret CAD model files that contain more than one distinct solid body.

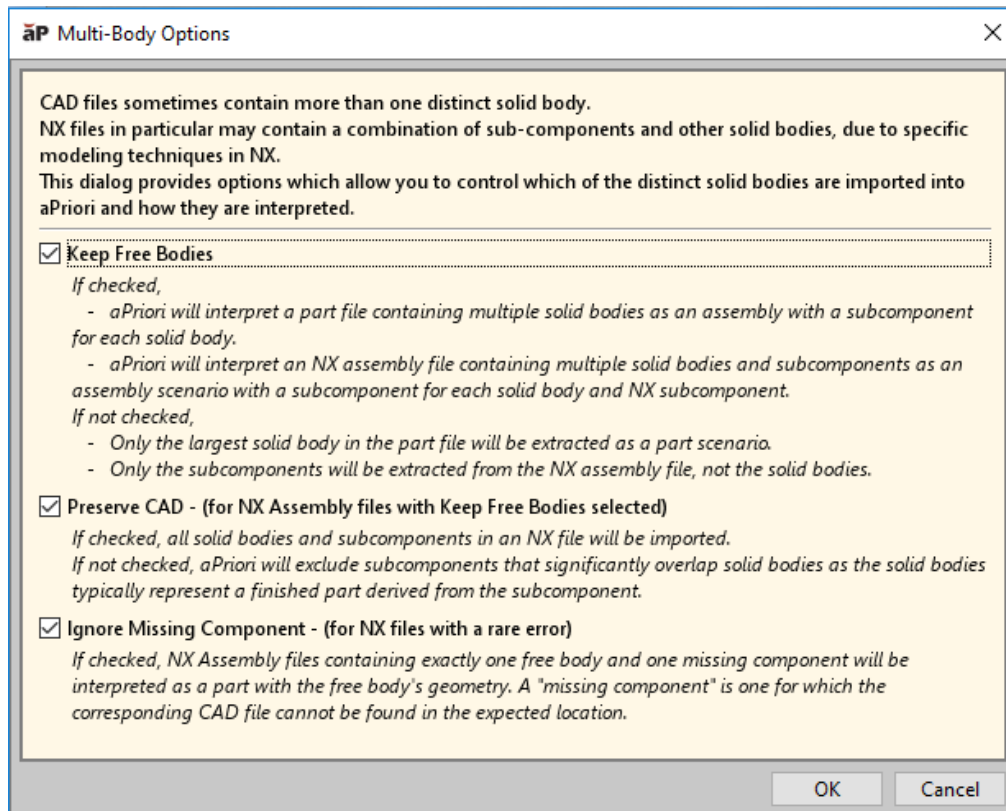
To open this dialog, select **Tools** → **User Preferences** → **Multi-Body Options**.



This dialog provides three options:

- **Keep Free Bodies**
- **Preserve CAD - (for NX Assembly files with Keep Free Bodies)** – only applies when **Keep Free Bodies** is selected.
- **Ignore Missing Component – (for NX files with a rare error)** – only applies when **Keep Free Bodies** is selected.

Each option in the dialog is fully documented:





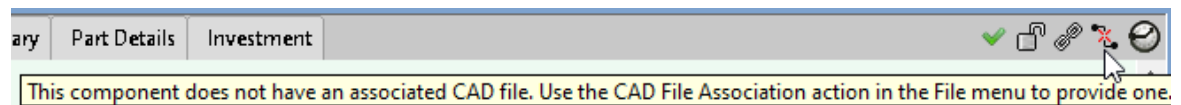
Prior to 2019 R1, the only way to change the processing of multi-body CAD files was to change the values of three corresponding entries in the `apriori.properties` file and then restart aPriori. These three properties are:

- o `apriori.keep.free.bodies`
- o `apriori.free.bodies.preserve.CAD`
- o `apriori.free.bodies.ignore.missing.component`

These properties are discussed in the aPriori Professional *System Administration Guide*, in the “`apriori.properties`” section. There is also a discussion later in this *User Guide* of using these properties with Bulk Costing at [Costing multi-body parts \(free bodies\)](#).

The **Multi-Body Options** dialog allows you to make these changes more quickly and easily without restarting aPriori. However, note that any changes to the options in this dialog will affect CAD files that you open *subsequently, not to already opened files*. If you open a CAD file and the current settings of those options do not produce your desired results, delete the unwanted/incorrect scenarios to avoid confusion in the future, *then* change the **Multi-Body Options** settings and reopen the file and re-extract GCDs.

**Caution:** Note that aPriori always applies the current settings of the **Multi-Body Options** when opening previously-saved scenarios. aPriori does NOT “remember and reapply” the settings which were in effect when the scenario was last saved. If the current settings are different than when the scenario was saved, the scenario will become disassociated from its CAD file, as indicated by the “broken connection” icon (see screenshot below).



If you observe this disassociation or otherwise believe the current **Multi-Body Options** settings are not appropriate for the scenario, do the following:

- Close the scenario *without saving it*.
- Change the **Multi-Body Options** settings as appropriate.
- Re-open the scenario.
- Re-associate the CAD file by clicking **File** → **CAD File Association** and selecting the CAD file.

## Displaying English units

By default, aPriori displays cost component information using metric units. However, you can also display values and enter inputs using English units.

The table below shows how aPriori converts between system units (metric) and English units.

aPriori unit type	System unit	English unit
Length	millimeter	inch

	meter	foot
	micron	micro inch
Mass	kilogram	pound (lbf)
	gram	ounce
Force	newton	pound (lbf)
Time	second	second
Angle	degree	degree
Temperature	Celsius	Fahrenheit
Energy	joule	BTU
Power	joule/second	BTU/second
Pressure	MPa	PSI

Some fields will not automatically be converted. For example, some cost model and VPE field definitions can be defined by manually entering a unit, rather than a unit type in the Unit Type Name field. If a unit in the cost model used by the VPE was defined by selecting an aPriori unit type from the cost model's Unit Type Name field, that unit is converted. All units derived from system units (that is, derived units) are also converted.

The Mass Units and Distance Units component GCD fields are never converted, because they are used to capture the mass and distance units used in the CAD file. These units do not change because they represent units defined in an external system.

### To display English units

- 1 Select **View > Show English Units** from the aPriori menu bar to change labels to English units and convert values from system units to English units.
- 2 Select **Yes** on the confirmation window to switch the display and input to English units.

Converted values are displayed in italics. For example, a Hole GCD with a diameter of 25.4 millimeters is displayed with a Diameter property followed by (in.) instead of (mm) and has a value of *1.0* after you switch to English units.

### To display system (metric) units

- 1 Deselect **View > Show English Units** from the aPriori menu bar to change labels to system (metric) units and convert values from English units to system units.
- 2 Select **Yes** on the confirmation window to switch the display and input to metric units.



# Connecting to and disconnecting from CAD

In Direct Integration mode, aPriori connects directly to the CAD application to retrieve geometry data of the MCAD component that is active in the CAD application. The costing information for the component is saved in aPriori database.



You can disconnect from the CAD application and reconnect as you need.

You can reconnect aPriori to the CAD application directly in aPriori Desktop or in the CAD application.

## To disconnect from the CAD application in aPriori Desktop

Click the  button. aPriori disconnects from the component that is currently active in the CAD application and you see the  button.


## To connect to the CAD application in aPriori Desktop

Click the  button. aPriori connects to the CAD application and you see the  button.

## To connect to aPriori in the CAD application


Select **aPriori > Start aPriori** or click the  button. This feature is available only for CAD applications that support Direct Integration mode.

# Closing a component in aPriori Desktop

To close a component, click the  button on the component tab. The component tab closes.












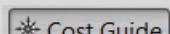

In Direct Integration mode, when you close a part or an assembly in the CAD application, that part or assembly remains open in the aPriori Desktop. You can close any component in the aPriori Desktop except for the one that is active in the CAD application.







# Switching to aPriori Cost Ticker

To switch to the aPriori Cost Ticker, click the  button in the aPriori Desktop toolbar. The Cost Ticker always shows cost information for the component that is active in the CAD application.

# aPriori Desktop icons and command buttons






The following table lists all the icons and command buttons available in aPriori Desktop and explains how they are used.

Icon	Usage
	Click this button to open a CAD file in CAD-Independent mode.
	Click this button to search for a component.
	Click this button to save the displayed cost. If the displayed cost is not current, the Save button is not available. If the Cost Outputs are not current, this button is unavailable.
	Click this button to cost a component.
	<p>Click this button to update the Geometric Cost Drivers (GCDs) from the CAD model and calculate new cost using the updated GCDs. Place the mouse pointer over this icon to see the date and time when the GCDs were last updated.</p> <p>In CAD-Independent mode, this button is only available when the component is file-connected.</p> <p>In Direct Integration mode, this button is only available for components open in the CAD system.</p>
	Click this button to enable manual cost overrides in the Cost Summary tab.
	(Pro/E Direct Integration mode only). Indicates that aPriori is connected to the CAD application. Click this button to disconnect from the CAD application.
	(Pro/E Direct Integration mode only). Indicates that aPriori is disconnected from the CAD application. Click this button to connect to the CAD application.
	<p>Click this button to display system status messages.</p> <p>The color of the Message button indicates the system status:</p> <p>Green indicates the system is functioning normally</p> <p>Yellow indicates a warning</p> <p>Red indicates an error</p>
	<p>Click this button to open the Production Info editor and specify the Total Cost Target. If the Total Cost Target is set and the current cost is:</p> <p>Between 90% and 110% of the target cost, the indicator on the Cost Target icon points straight up</p> <p>Less than 90% of the target cost, the indicator points to the left</p> <p>More than 110% of the target cost, the indicator points to the right</p>
	Click left and right arrows to navigate back and forward through the open item tabs in the order that they were last visited.
	Click this button to toggle the display of the Cost Guide. See <i>Initial costing: The Cost Guide</i> for more information.
	Click this button to switch to aPriori Cost Ticker.

Icon	Usage
	Appears if the current scenario is designated as "Official"; otherwise not present
	Indicates whether the current scenario is locked or unlocked.
	Indicates whether the current scenario is Active (will re-extract and update GCDs from CAD models) or Inactive (will not extract GCDs).
	Indicates whether the current component is connected to a CAD file; hovering over the icon will display a tooltip with the path to the CAD file location or a statement that there is no associated CAD file (either because aPriori cannot locate it, or the component is a virtual part that has no CAD association).
	indicates whether the current component costs are up-to-date, or they are "stale", meaning that the component has not been re-costed since costing inputs were modified. Hovering the cursor over the icon will display when the component was last saved and by whom.
	The <b>Cancel</b> icon appears in the lower-right corner of the aPriori desktop window during costing operations. See <i>To cancel a costing operation on page 48</i> for details.

## Cost Status Icons

The following icons appear in Status columns (such as in the Assembly Details view) to indicate the costing status of components within a table:

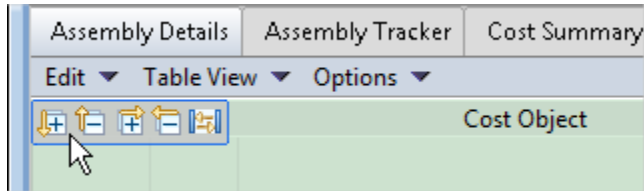
Icon	Usage
	Green: aPriori has successfully costed the component.
	Yellow: aPriori has successfully costed the component, but with one or more warnings.
	Red: aPriori was not able to successfully cost the component.
	Gray: Component has not yet been costed.
	Asterisk added to one of the above icons: The component has unsaved changes. To save the changes, right-click the component and select <b>Save</b>






## aPriori Desktop table controls

aPriori uses tables to present data throughout the application. To help operate with table data, the following table features are provided in most tables:

- Trees inside tables — In some tables a column can be a tree of data. To expand/collapse the tree, click on the +/- icon next to an item in the tree.

- Column groups — Some tables have groups of columns, which can be expanded and collapsed. Initially the groups are collapsed showing only the first three or four columns. Click the + icon on the last visible column to expand the group; click the – icon on the last expanded column to collapse the group.
- One-click all column controls — In some large tables, one-click controls are provided to expand and collapse all trees and columns. To view these controls, move the cursor to the upper left corner of the table. You see a floating panel with the relevant controls.



Icon	Usage
	Expands all tree data.
	Collapses all tree data.
	Expands all column groups.
	Collapses all column groups.
	Resizes columns to fit data.

These controls may not be available on all tables, particularly smaller tables in specialized windows.

- Fixed leading columns — In aPriori tables the leading columns are fixed.
- Copy — To copy data from the table into the clipboard, click the **Edit** menu for this table and select **Copy**. Only the visible data is copied to the clipboard. To copy all data from the table, use the one-click controls to expand all tree data and column groups. You can paste the data into any spreadsheet.



# 5 Using aPriori Desktop

This chapter provides detailed information on how to use aPriori Desktop.

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This chapter includes the following topics:

- Working with scenarios
  - Importing and exporting component costs
  - Importing BOMs
  - Using the component viewer tools and commands
  - Using roll-ups
  - Using dynamic roll-ups
  - Using functional groups
  - Reapplying functional groups templates
  - Comparing the costs of alternative designs
  - Creating new components without CAD
  - Working with non-CAD-based assembly components
  - Overriding computed values
  - Working with the Overrides Summary dialog
  - BOM reports
  - Spreadsheet Reports
  - Bulk editing components
-

## Working with scenarios

When you open a component in aPriori and perform the initial costing, an initial cost scenario for the component is created and displayed on a component scenario tab and within the component's Scenarios folder on the Navigation pane. The initial scenario is shown with (Initial) in the name of the component scenario tab. As you make changes to the component's geometry or manufacturing process, you can save those changes in multiple cost scenarios.

You can create scenarios for parts, assemblies, roll-ups or comparisons:

- A **part** scenario shows the cost of manufacturing the part using the specified GCDs and Manufacturing process.
- An **assembly** scenario shows aggregate costs from the part sub-components, the assembly sub-components, and the assembly process. Creating an assembly scenario generates a new scenario for the current assembly which contains default scenarios of all subcomponents based on a **User Preferences** setting. You can also specify that other part scenarios roll into the assembly. You can change a single component, or a component and all of its children, using the **Scenario** menu (see *Using the Scenario Menu* below). From Assembly Detail view, you also have the option of selecting any number of components and using the right-click **Switch Scenario** option to rapidly change several components to other scenarios. See *Switching Scenarios in Assembly/Roll-up Details view* on [page 74](#) for more details.
- An **assembly snapshot** scenario shows aggregate costs from the part's subcomponents, the assembly's subcomponents, and the assembly process. Creating an assembly snapshot automatically creates locked associated scenarios for all assembly components.
- A **roll-up** or **comparison** scenario contains aggregate costs from the part, assembly, and virtual cost objects components.

You cost just the currently selected, top-level scenario, or you can cost all scenarios. In the case of assemblies, you can also “deep cost” – you can cost the current scenario and all of its children; and even cost all scenarios and all of their children.

aPriori gives you a great deal of control over scenarios as you try different costing options. You can specify that different part scenarios – not just “official” -- roll into a given assembly scenario. You can specify whether or not scenarios are automatically updated by CAD changes (“active” or “inactive”). And you can specify whether scenarios (or scenarios and their children) are locked against changes.

You can also copy changes from an assembly to all its children.

For more information on containers, see *Using roll-ups* on [page 95](#) and *Comparing the costs of alternative designs* on [page 105](#).

Note: In addition to the menu commands described in the next section, aPriori also provides the following keyboard shortcuts:

Ctrl-S – Saves the current scenario

Ctrl-Shift-L – Opens the Latest (i.e., “most recent”) scenario




## Using the Scenario Menu

The commands associated with scenarios have been consolidated on the top-level **Scenario** menu. Some of these options are also available on various right-click context menus.

**Note:** The **Scenario** menu options do not apply to whatever is highlighted in the navigation pane – they apply only to what is currently open. So, for example, if you want to use **Scenario > Lock** on a particular scenario that appears in the navigation pane, you must first open that scenario by double-clicking it, or right-clicking and selecting **Open**. (Of course, similar options on the right-click menus do apply to the currently selected item in the navigation pane.)

**Scenario >**

<b>Save &gt;</b>	<b>Scenario</b> (if any) to children,	– Save changes to the currently selected scenario. Do not save changes
	<b>Scenario &amp; Children</b>	(Assemblies and roll-ups only) Save changes to the currently selected scenario and any changes to children.
	<b>All Scenarios &amp; Children</b>	-Save changes to the currently selected scenario and any changes to children.
<b>Save as &gt;</b>	<b>Scenario</b>	Make a copy of the current scenario as a new scenario. The new scenario will have the same children as the original.
	<b>Scenario &amp; Children</b>	(Assemblies and roll-ups only) Make a copy of the current scenario as a new scenario, and also make copies of any children. The name of any child scenario will have the name of the parent scenario appended.
	<b>Snapshot</b>	(Assemblies and roll-ups only) Make a copy of the current scenario and lock it and its children against further changes.
<b>Copy Assembly Inputs to Children</b>	-	Displays the list of production values (such as VPE, annual volume, batch size, etc.) that applies to the assembly, along with a checkbox for each value. By checking the boxes, you can determine which of these values gets copied to each of the children in the assembly. User-defined attributes are included in this list, appended to the end. See <i>Copying assembly cost settings to children</i> on <a href="#">page 40</a> for more information.
<b>Copy Welds From</b>	-	(Assemblies only) Brings up a Search dialog so that you can choose another assembly with similar geometry from which to copy virtual welds. See <i>Virtual welds</i> on <a href="#">page 80</a> .
<b>Make Official</b>	-	Specify that the current scenario is to be made the “official” scenario. When used in conjunction with the <b>Tools &gt; User Preferences &gt; Use Official Scenarios in New Assemblies</b> option, you can specify whether the official scenario by default gets rolled into its parent assembly or roll-up. This option is not available for uncosted or locked scenarios, or scenarios that are already marked official.
<b>Make Active/Inactive &gt;</b>	<b>Make Active (Scenario)/Make Inactive (Scenario)</b>	Specify whether or not the selected scenario is automatically updated with CAD changes. Note that roll-ups cannot use this option since they are not CAD-connected, but they have access to the following options for their members.)
	<b>Make Active (Scenario &amp; Children)</b>	Specify that the selected scenario (if CAD-connected) and all of its children are automatically updated with CAD changes. (The status of any locked children remains unchanged.)

	<b>Make Inactive (Scenario &amp; Children)</b>	Specify that the selected scenario (if CAD-connected) and all of its children are NOT to be automatically updated with CAD changes. (The status of any locked children remains unchanged.)
<b>Lock/Unlock &gt;</b>	<b>Lock Scenario/Unlock Scenario.</b>	– Allow or disallow changes to the current part or assembly scenario. Roll-ups cannot be locked, but the options below can be used for the members of a roll-up
	<b>Lock Scenarios (Scenario &amp; Children)</b>	Disallow changes to be made to the members of an assembly or roll-up (and also to the parent assembly).
	<b>Unlock Scenarios (Scenario &amp; Children)</b>	Allow changes to be made to the members of an assembly or roll-up (and also to the parent assembly).
<b>Enable Cost Overrides</b>	-	Displays checkboxes next to line items in the Cost Summary view that allow you to enter your own values for costing. Same as clicking the <b>Cost Overrides</b> icon (  ) in the tool bar. See <i>Performing Part Details overrides on page 113</i> for more information.
<b>Manually Costed</b>	-	Displays checkboxes next to every editable cost value. In addition, all check boxes are checked and disabled, indicating that all costs are specified manually and are not affected by changes to the components GCDs, non-geometric cost drivers, or VPE data. See <i>Performing total cost summary overrides on page 120</i> for more information.
<b>Attach 2D Image</b>	-	Provides the ability to associate a graphics file with a virtual component. The image is displayed as a thumbnail and in the component viewer.
<b>Remove 2D Image</b>	-	Disassociates an image that has been associated with a component using the <b>Attach 2D Image</b> command.
<b>Create Comparison</b>	-	Creates a Comparison Summary view starting with the currently selected scenario. See

## Creating and editing scenarios and snapshots

### To create a new scenario


- 1 Activate the component scenario tab that you want to use as the starting point for the new scenario.
- 2 Select **Scenario > Save as > Scenario** from the menu bar. For assemblies only, you also have the option of saving a **Snapshot**, which is a locked scenario.

For all components, you also have the option of selecting **Scenario & Children** to perform a “deep” save, which saves not only the current scenario, but all of its children scenarios as well.

You can also access these operations by right-clicking the scenario name in the navigation pane.


- 3 Enter a unique name for the scenario in the Name field.
- 4 (Optional) Enter a description of your changes in the Description field. If the source scenario has a Description field defined, that text automatically populates the Description field on the Save As dialog.
- 5 Click **OK** to display the scenario in a new component scenario tab and in the component's Scenarios folder on the Navigation pane.

### To edit a scenario

- 1 Activate the scenario tab that you want to edit.
- 2 Make the changes.
- 3 Click the  button to save the changes.

## Saving a scenario

After making changes to a scenario you can:

- Save your changes in the same scenario by clicking the  button or selecting **Scenario > Save > Scenario**. You can also perform a “deep” save by selecting **Scenario & Children**.
- Enter a name for the new scenario.

## Working with initial scenarios

When you open a component in aPriori and perform the initial costing, an initial cost scenario for the component is created and displayed on a component scenario tab and within the component's Scenarios folder on the Navigation pane. The initial scenario is shown with the name Initial. (You can change the default name that aPriori uses for initial scenarios with **Tools > User Preferences > Default Scenario Name**)

As you make changes to the component's geometry or manufacturing process, you can save the changes in multiple cost scenarios.

## Working with official scenarios

One scenario for each component must be the official scenario. The official scenario is simply the scenario which will roll-up into an assembly or roll-up by default, if you have not specified any other scenario.

For snapshots, roll-ups, comparisons, or analyses, the initial scenario is always the official scenario.

In versions of aPriori before 2014 R1, the official scenario also controlled whether a CAD-connected component could automatically be updated whenever its CAD file changed, but this is now controlled by a separate active/inactive setting.

When you open a component, the official scenario for the component opens by default. To open a different scenario, you can specify it from a list of the component scenarios, or by specifying it on the **Open CAD File** dialog. For more information, see [Opening a component in aPriori on page 19](#).

### To make a part or assembly scenario the official scenario

Do one of the following:

- In the Navigation pane, right-click a part or assembly scenario and select **Make Official** to make it the official scenario.
- Select **Scenario > Make Official** from the aPriori menu bar to make the current component scenario the official scenario.

## Locking and unlocking scenarios

As a component design is evolving, you might want to capture the cost at particular stages and keep it without changing for future references. If you do not want any changes to be made to a particular scenario, you can lock that scenario to prevent editing.

Locking an assembly scenario does not lock the assembly's subcomponent scenarios. Because the cost of active subcomponent scenarios can change, those changes are reflected in the locked assembly scenario costs. Create an assembly snapshot if you want to lock the assembly and all its subcomponents. For more information, see [Using the Scenario Menu on page 67](#).

### To lock a scenario

Do one of the following to lock a scenario:

- Right-click the scenario in the Navigation pane and select **Lock** from the context menu.
- Select **Scenario > Lock Scenario** from the aPriori menu bar.
- Right-click a cost object on the Assembly Details tab and select **Lock** from the context menu.

The scenario icon displayed in the Navigation pane and on the component scenario tab changes to show that the scenario is locked. The Assembly Details tab also provides a Locked column indicating the lock status of a scenario.

Roll-up snapshots and comparison snapshots are locked automatically.

### To unlock a scenario

Do one of the following to unlock a scenario:

- Right-click the locked scenario in the Navigation pane and select **Unlock** from the context menu.
- Select **Scenario > Unlock Scenario** from the aPriori menu bar.
- Right-click a cost object on the Assembly Details tab and select **Unlock** from the context menu.

The scenario icon displayed in the Navigation pane and on the component scenario tab changes to show that the scenario is unlocked, and the scenario can be edited.

Roll-up snapshots and comparison snapshots are locked automatically and cannot be unlocked.

## Locking the scenario of a part or assembly

You can lock an assembly to preserve a specific state of the assembly costs and prevent unauthorized edits at the subcomponent level.

Locking a component scenario affects the behavior of the application when refreshing GCDs or updating the CAD model. aPriori attempts to open and update any active scenario GCDs whenever a CAD model is opened or modified in the CAD system. If an active scenario is locked, the update is not possible, and you are presented with a window with the following options:

- Open the locked scenario without updating.
- Create a new scenario and update it with new GCDs. The new scenario does not become the official one, even if the original was the official scenario. The original scenario remains locked.
- Pick another existing unlocked scenario and update it with new GCDs. The original scenario remains locked and unchanged. (Note: This last option is only available if other unlocked scenarios exist for the part)

Locking the official scenario of an assembly prevents assembly GCDs from updating and prevents access to all assembly-level edit commands. The Assembly Details tab provides a Locked column indicating the lock status of a scenario.

## Refreshing the current scenario

At any time during the costing process, you can cancel all unsaved changes and refresh the current scenario with information stored in the aPriori database. You might want to do this if you want to overwrite your current edits with the last saved version of the component.

### To refresh the current scenario from the database

- 1 Select **File > Refresh the current Scenario from the Database** to display the Confirm Scenario Refresh window.
- 2 Click **OK** to refresh the scenario with information saved in the database. All unsaved changes are lost.


















### To refresh GCDs from the CAD model

Right-click a scenario in the Navigation pane and select **Refresh GCDs from CAD Model** from the context menu.

Use this command to pick up CAD changes that do not automatically trigger GCD changes in aPriori.

## Identifying types of scenarios

The icons on the scenario tabs and in the navigation pane indicate the type of scenario:

Icon	Usage
	Official part scenario.
	Official scenario of the part that is: In Direct Integration mode – active in the CAD application. In CAD-Independent mode – file-connected and current in aPriori.
	Locked official part scenario.
	Unlocked part scenario
	Locked part scenario
	Official assembly scenario
	Official scenario of the assembly that is: In Direct Integration mode – active in the CAD application. In CAD-Independent mode – file-connected and current in aPriori
	Locked official assembly scenario
	Unlocked assembly scenario
	Locked assembly scenario or snapshot
	Official roll-up scenario
	Roll-up scenario
	Roll-up snapshot
	Dynamic roll-up scenario
	Official comparison scenario
	Comparison scenario
	Comparison snapshot

## Deleting a scenario

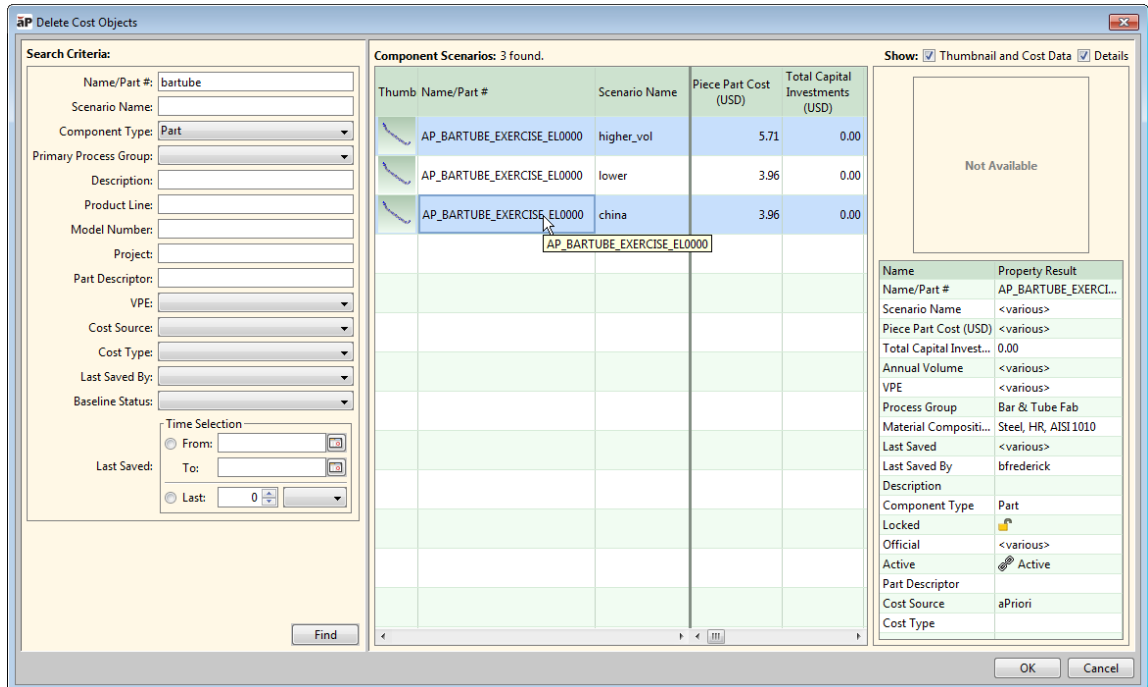
You can delete scenarios within the following guidelines. When you delete:

- A non-official scenario of a component, only that scenario is deleted.
- The official scenario, either by itself, or with one or more (but not all) other scenarios of the same component, the selected scenarios are deleted, and an arbitrary remaining scenario is made the official scenario.
- All scenarios of a component, it is the same as deleting the component..

**Note:** You should use the **Tools -> Delete Components..** menu option when deleting scenarios. Although the **Navigation** pane provides a **Delete Scenario** context menu option, this menu does not allow deleting multiple scenarios at once, not does it allow you to delete the official scenario.

## To delete a scenario

- 1 From the aPriori menu bar click **Tools > Delete Components**.
- 2 In the **Delete Cost Objects** window, search for the scenarios of interest. (See *Using the Search tool* for more information.)
- 3 Click on the scenario to delete. To expand your selection to multiple scenarios, use **Shift-click** and **Ctrl click**.



- 4 Click **OK**, then click **Yes** when prompted to confirm the deletion.

## Switching Scenarios in Assembly/Roll-up Details view

When in Assembly Details or Roll-up Details view, you have the option of selecting a number of sub-components and changing all of them to either a specific scenario, or to each of their official scenarios.

The possible scenarios to switch to include those that exist for each selected component. For example, if "prelim" exists for all selected components, then that will show as an option. If "myCopy" only exists in one of the selected components, then it will not show up as an option.

In addition to the common scenarios, the top of the pop-out menu also shows **"Official Scenario (<various>")**. This allows you to switch to the official scenario for all selected components.

**Note:** There is a difference between selecting the scenario "Initial" and the official scenario which happens to also be "Initial". Selecting the official one will put parentheses "( )" around the name in the viewer and more importantly it will "float". That is, if someone changes what the official scenario is, it will automatically update in the respective assemblies. If just "Initial" is selected then it will not float.



When multiple components are selected, the pop out menu does not display a green status dot next to the currently selected scenario, since the status could be different for each component. A green dot appears only when one component is selected.

Similarly, if only one component is selected, aPriori displays its official scenario name at the top of the pop-out menu. Otherwise, (<various>) is shown.

If you attempt to switch to an inactive scenario, aPriori warns you that the geometry may not be up to date. See *Active and inactive scenarios* on page 18 for more information.

**Note:** When only one component is selected, the popup menu will provide a **Show More >>** option. This displays the standard Search dialog, but with the Name/Part # and Component Type: fields pre-populated and uneditable. See *Using the Search tool* on page 37 for more information.

## To switch scenarios of assembly components

- 1 From the Cost Object section of the Assembly Details view, select a component.
- 2 Right-click and select **Switch Scenario**.

Status	Level	Name	Scenario	Quantity	Annual Volume	Material Compositi	Fully Burdened Cost (USD)
● *	0	AP_ASSEMBLY_EXERCISE_EL0000	Initial	1	5,500		3.32
●	1	Assembly Processes			-		0.36
⚠	1	AP_SHEETMTL_EXERCISE_EL0000	Initial	1	5,500	Steel, Cold ...	1.65
⚠	1	AP_BRACKET_HANGER_EL0000		1	5,500	Steel, Cold ...	0.85
⚠	1	WELD_SUPPC		1	5,500	Steel, Cold ...	0.39
⚠	1	FASTENER_EL		1	5,500	Steel, Cold ...	0.07
●	-	Sheet Me			-		0.07
●	-	Mater			-		0.00
●	-	Laser			-		0.07
		Component Sub					
		Assembly Proce					
		GRAND TOTAL					

- 3 Select either **Official Scenario** at the top of the pop-out menu, or one of the options listed below **Select Specific Scenario**.

**Note:** You can select multiple components and change all of them to their Official scenario(s).

Status	Level	Name	Scenario	Quantity	Annual Volume	Material Info	Fully Burdened Cost (USD)
● *	0	AP_ASSEMBLY_EXERCISE_EL0000	Initial	1	5,500		3.32
●	1	Assembly Processes			-		0.36
●	1	AP_SHEETMTL_EXERCISE_EL0000			5,500	Steel, Cold ...	1.65
●	1	AP_BRACKET_HANGER_EL0000			5,500	Steel, Cold ...	0.85
●	1	WELD_SUPPORT_EL0000			5,500	Steel, Cold ...	0.35
●	1	FASTENER_EL0000			5,500	Steel, Cold ...	0.07
●	-	Sheet Metal			-		0.07
●	-	Material Stock			-		0.00
●	-	Laser Cut			-		0.07
-	-	Component Subtotal					2.96
-	-	Assembly Processes Subtotal					0.36
-	-	GRAND TOTAL					3.32

Non-official scenarios are not available during multi-select. Further note that when you have only one row selected, the Switch Scenario fan-out menu also provides a **Show More** option, which displays the Search tool for finding additional choices. See *Using the Search tool* on page 37 for more information.

## Importing and exporting component costs

aPriori allows you to export part and assembly cost information from one aPriori database and import it into a different aPriori database. The files used for these imports and exports have “.ap” extensions. This data-sharing capability enables manufacturers to collaborate with their suppliers and other third parties, such as consultants, who are supporting their design and sourcing activities. This functionality also allows users in a location with a slow connection to the primary database server to work with a local database to improve performance and then transmit the costed components to the primary database.

### Functional overview

Import and Export can be accessed from the **File** menu.

- **File > Export > Current Scenario & Children** exports the current scenario, (the part, assembly or rollup that you see on your screen) plus any children belonging to that scenario, to an .ap file that you specify.

- **File > Export > Select Scenario(s)** displays the search menu which you use to select the part, assembly or rollup (group of parts) that you want to export.
- Tools **File > Import** allows you to select the .ap file that you want to import.

## Basic workflow for sharing data

This example explains the workflow between two sites of the same manufacturing company or between a manufacturer and their contract engineering firm). For the purposes of this explanation, it is assumed that the Manufacturer is located in the US and the Contract Engineering Firm is located in India.

- 1 An engineer in the US initiates a work order for costing a set of parts. This is typically 10 -50 parts but could be up to 100.
- 2 An engineer in India executes the work order by costing the parts in aPriori.
- 3 An engineer in India saves each part as a new scenario, gives the scenario a unique name, and makes the scenario 'official'. \*

**Note:** The scenario name must not contain a colon.

- 4 On a periodic basis, or when the work order is complete, an engineer in India creates a rollup and adds all the scenarios in the work order into the rollup.\*\*
- 5 An engineer in India exports the rollup from aPriori which creates a file on disk. This will be a menu option from the aPriori user interface.
- 6 The exported file is made available to users in the US. This could be done by simply being placed in a shared folder to which users in both the US and India users have access.
- 7 A user in the US imports the file using aPriori.

\*The naming convention is to be determined by the aPriori customer. The purpose for the unique scenario is so that it does not overwrite data in the US database if the part already exists there (unless that is the desired behavior). Note that the scenario name must not contain a colon.

\*\*The timing of when the export is done is to be determined by the aPriori customer. When adding parts to the rollup, parts can be added based on a date range, VPE, or the user ID of the person who last saved the part, among others. There is a practical limit to the number of parts that can be placed in a rollup and exported. The exact number depends on the computer being used and the complexity of the parts in the rollup. On a typical 32-bit workstation, it should handle 100 parts without problem. This number is increased significantly by using a 64-bit workstation and increasing the amount of installed memory.

**The file transfer mechanism works in either direction.** Therefore, if a user in the US makes changes to a part and wants a user in India to see those changes, the US user can export it, and the India user can import it.

## Data Integrity: What happens when a part being imported already exists in the database

It is important to understand the behavior when importing a part when that part number already exists in the database.

When importing a part or group of parts, if any of the part number/scenario combinations already exist in the database, the list of parts which do already exist will be displayed. You will then have the option to cancel the import or proceed. If they choose to cancel, nothing will be imported. If they choose to proceed, all of the parts will be imported and the ones which already existed will be overwritten (regardless if they are locked or unlocked). If none of the parts being imported exist in the database, you will not be prompted at all.

If part 123456.initial exists in the database and is the only scenario for part number 123456, and 123456.india is imported. Scenario 123456.initial will remain and 123456.india will be added. If 123456.india was official when it was exported it will become the official scenario when it is imported.

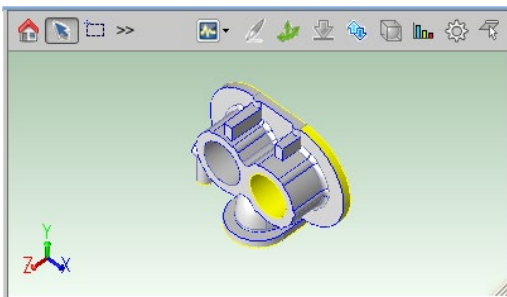
Therefore, when a user in India costs a sub-assembly, they will need to export the “.initial” scenario so that its cost will be pulled into the higher-level assembly. As described above, if that sub-assembly already exists in the US database it will be overwritten upon import.

## Importing BOMs

Documentation about the aPriori BOM Loader can now be found in the aPriori *VPE Admin Guide*.

## Using the component viewer tools and commands

aPriori Component Viewer provides a number of tools and commands to display and edit GCDs for a part or an assembly. The available tools and commands vary depending on the Manufacturing Process Group.




**Note** You can access the Component Viewer tools and commands only when the cost of the part or assembly displayed in the Component Viewer is current. If the cost is not current, click the **Cost** button to calculate the current cost and allow access to tools and commands.

The following tools and commands are available in the Component Viewer:

- Analysis – Displays a list of characteristics that can be displayed on the component in the viewer
- Welding – Create a virtual weld for an assembly
- Setup Axis – Display setup & turning axes, Modify setup axes, and Limit turning axes
- Stock Form and Alignment – Display the automatically-chosen stock shape and alignment and override it
- Draw Direction/Ram Direction – For plastic molding, manually select the draw direction in which the part mold is opened. For Sheet Metal - Transfer Die, manually select the direction of the ram.
- Geometry Analysis – Identify which GCDs have properties or characteristics that drive costs
- Gear Definition -- Display the **Gear Definition** dialog; only enabled when displaying a part that includes gears, flutes, splines, or sprockets. See the "Working with Gears, Splines, Sprockets, and Flutes" section of the *aPriori Cost Model Guide* for more information.
- Set Main Surface for Sheet Metal Parts -- Display the **Set Main Surface** dialog. Only enabled when displaying a sheet metal part. See the "Main Surface for Hard Tooled Sheet Metal" section of the *aPriori Cost Model Guide* for more information.
- Flattening Options -- Displays the **Flattening Options** dialog. Only enabled when display a sheet metal part. See the "Flattening" section of the *aPriori Cost Model Guide* for more information.
- Right-click menu commands
- 2D Images for virtual parts that have no CAD model image (*available in 2014 R1 SP1 and later*) – **Attach 2D Image**, **Remove 2D Image**, and **Close** viewer

## Displaying part characteristics

Click the  button in the Component Viewer tool bar to bring up the list of characteristics that you can display for the part opened in the Component Viewer. Different characteristics can be displayed for different Manufacturing Process Groups.

**Note** The display options are available only for parts.

Once you select a characteristic, it is displayed in the Component Viewer and the corresponding GCDs are highlighted in the GCD pane.

The following display options are available:

- **Show GCD Labels** — available for all Process Groups — displays GCD labels for all highlighted GCDs.
- **Setup Axes** — available for Bar & Tube, Casting, Machining, and Sheet Metal Process Groups — shows the setup axes to be used for machining. The setup axes can be created automatically by aPriori or manually by you.
- **Cross Section** — available for the Bar & Tube Process Group — shows the cross section of the stock material.

- **Turning Profile** — available for turned parts (Bar & Tube Fabrication or Casting primary process groups — displays the turning profile (cross-section of the part on a plane passing through the turning axis).
- Note: to highlight axisymmetric volumes removed by turning operations in the Component Viewer, you can select Ring GCDs in the Geometric Cost Driver pane.
- **Parting Line** — available for Casting and Injection Molding Process Groups — shows the line dividing the top/left side of the mold from the bottom/right side of the mold.
- **Projected CSA** — available for Casting and Injection Molding Process Groups — shows projected cross section area for the part.
- **Thickness** — available for Casting and Injection Molding Process Groups— shows the minimum and maximum thickness of the part walls.
- **Cores** — available for Injection Molding Process Group — highlights moving side cores.
- **Material Nesting** — available for Sheet Metal Process Group — shows how the part's flat outline is nested within a stock material sheet.
- **Flat Outline** — available for Sheet Metal Process Group — shows the smallest rectangle that encloses the part before bending.


## Copying the component image to the clipboard

You can copy the image that is displayed in the component viewer to the clipboard for pasting into other utilities like Microsoft Word, Excel, or image editing packages.

- 1 Click to select the image in the component viewer.
- 2 Click **Tools > Copy Image** from the toolbar.

## Virtual welds


Virtual welds are created in aPriori as opposed to a CAD application. You can create welds for assemblies, as well as for edges and holes of a single Sheet Metal or Bar & Tube part. Various weld processes (manual and robotic MIG and TIG welding, manual and robotic spot welding, and laser and electron beam welding) and types of welds (bevel groove, v-groove, j-groove, u-groove, square-groove, fillet, wrap-tie, tack welds, and plug welds) are supported. Weld prep and weld cleanup processes (including bevel cutting, grinding, and wire brushing) also may be optionally included.

For assemblies, you can create a virtual weld using the Welding tool  in the Component Viewer tool bar.

To apply a weld to an edge or hole of a part, select the GCD, then right-click and select Edit Operation from the right-mouse popup menu. The Operation Sequence Selection dialog appears, allowing you to specify the desired weld processes and weld types.

Part-welding processes are included in a secondary process group called Part Assembly, and this capability is licensed along with the Welding module.

### To create a virtual weld

- 1 Open an assembly.
- 2 Click the Welding tool  in the Component Viewer tool bar.

The mouse cursor within the Component Viewer turns into a welding torch, the same as on the Welding button. The weld properties window opens.
- 3 Specify the following weld properties:
  - **Weld Type** — Select the type of the weld. Different weld types are represented with schematic pictures. Move the mouse cursor over a picture to see the name of the weld type.
  - **Production Mechanism** — Select manual or robotic production mechanism.
  - **Weld Width (mm)** — Enter the width of the weld in millimeters.
  - **Weld Depth (mm)** — Enter the depth of the weld in millimeters.
  - **Enable Intermittent/Pattern Weld** — Check this box to create a non-contiguous weld. For an intermittent weld, define:
    - **Segment Length (mm)** — The length of a weld segment in the intermittent weld.
    - **Pitch (mm)** — The distance from the beginning of one weld segment to the beginning of the next weld segment.
  - **Override Total Length** -- By default, aPriori automatically calculates the length of a weld, and displays this value in the **CAD Reference Length** field. You can override this value by clicking the checkbox and entering your own value in the **Total Length** field.
- 4 Click on an edge in the Component Viewer where you want to create the weld. Click **Create Weld** button. To create a virtual weld consisting of multiple edges, click each edge and then click the Create Weld Button.
- 5 Repeat steps 2 - 4 to create more welds.
- 6 Close the weld properties window by selecting **Cancel** or the **red X** in the top right corner of the window.

### To edit a virtual weld

- 1 Open an assembly.
- 2 Highlight a virtual weld either in the Component Viewer or in the GCDs pane.
- 3 Right-click the Virtual Weld and select **Edit** from the menu. The weld properties window is displayed.

**Note** You can select multiple welds by holding down the Ctrl key or the Shift key and clicking the welds.
- 4 Edit the weld properties as required.

- 5 Click **OK**.

### To copy virtual welds

Once you have created virtual welds for an assembly, other assemblies with similar geometry can import these welds through the **Scenario > Copy Welds from...** menu option.

- 1 Open an assembly.
- 2 Click **Scenario > Copy Welds From...**  
This opens the Search window. (See *Using the Search tool on page 37* for more information.)
- 3 Use the **Search** window to find and open the assembly, which has the virtual welds that you want to copy to the open assembly. This source assembly must have geometry that is very similar to the open assembly -- in other words, they must be different versions of the same assembly that differ only in a few details, or which have different part numbers.
- 4 At the end of the copy, aPriori generates a Weld Diagnosis spreadsheet report to help you evaluate the success of the copy operation, note that the information of interest in this report is on the first tab, "**Copy Welds Analysis Report**". The other tabs contain raw data that is used to create the first tab. (You can also run this report at any time using the **Reports > Spreadsheet Reports** menu item. (For more information about spreadsheet reports, see Spreadsheet Reports on page 316.)

All existing virtual welds in the destination assembly are discarded and are replaced by the imported welds. The imported welds retain the same weld IDs they had in the source assembly. Any non-virtual (CAD-defined) welds in the target assembly are kept, but they moved to the end of the weld list (i.e., they have IDs that start after the imported weld ids).

If there are no welds in the source assembly, or if aPriori fails to import all welds, then nothing changes in the target assembly; existing welds are not discarded.

**Note:** Because the two assemblies that the welds are being copied between must be "substantially similar", the following limitations apply:

- Mirrored assemblies are not supported. Some welds may get copied, but the results will not be reliable.
- Any weld that has more than about a 30% change in location or size will have varied copy results.

### To view virtual welds

- 1 Open an assembly.
- 2 In the Geometric Cost Drivers pane, click **Joining > Welds > Virtual Welds**. The list of virtual welds opens.
- 3 Click on a virtual weld to display its properties in the GCD pane and to highlight it in the Component Viewer.



### To delete a virtual weld



- 1 Open an assembly.
- 2 Highlight a virtual weld either in the Component Viewer or in the GCDs pane. To select several welds, hold the **Ctrl** button while you click on welds.
- 3 Right-click the Virtual Weld and select **Delete** (in the Component Viewer) or **Remove** (in the GCDs pane) from the menu.

## Part setups for machining

Please refer to the section "Working with Part Setups and SetupAxis GCDs" in the *aPriori Cost Model Guide* for a detailed discussion of part setups for machining. A part setup represents a particular orientation that a part may be placed in during the machining of that part. aPriori automatically determines the number of part setups required according to machining best practices. The Component Viewer tools allow you to add additional setups if desired and visualize the currently-used setups and additional potential setups.


The **Setup Axis** tool is available in the Stock Machining Process Group and when machining is used as a secondary process in manufacturing the part.

### To display currently used setups and potential setups

- 1 Click  in the Component Viewer tool bar. The list of display options opens.
- 2 Select **Active Setup Axes** to see the setups that are actually being used in the machining of the part.
- 3 Select **Inactive Setup Axes** to see the potential setup orientations that are not currently used for the selected machining routing and operations.
- 4 Alternatively, you can click the **Setup Axis** tool  in the Component Viewer tool bar and then select **Display Setup and Turning Axes...** The resulting window allows you to independently display both active and inactive (candidate) setup axes.

For more techniques about displaying setups and associated machining, see the section "Displaying Setups, Associated Operations, and GCDs" in the *aPriori Cost Model Guide*.

### To define or activate a setup axis

- 1 Click on the **Setup Axis** tool  in the Viewer tool bar, then select **Modify Setup Axes...**
- 2 In the **Modify Setup Axes** window, click the +Add button to indicate you wish to add a new part setup orientation. aPriori will highlight all inactive setup axes as gray arrows.
- 3 You can use your cursor to click on an inactive axis and select it. Alternatively, you can select on a planar face or curved wall GCD, to select the axis perpendicular or parallel to those surfaces respectively.

- 4 The axis will appear in the list of User-Activated axes and will be highlighted in blue in the Viewer window.

Upon subsequent costing, aPriori now will consider any user-defined setups as well as system-computed setups when evaluating which machining operations are possible for different GCDs.

### To deactivate a setup axis

You cannot de-activate setup axes that were automatically determined by aPriori. You can de-activate setup axes that were added by a user. In the **Modify Setup Axes** window, select an axis from the list of User-Activated Axes, and click the **Make Inactive** button.

## Turning axes


A Turning Axis is the axis of revolution for axis-symmetric geometry, which could be manufactured by turning processes. A part may have more than one turning axis. See the section "Turning Axes" in the aPriori *Cost Model Guide* for more information on turning axes, including system-created and user-defined turning axes.

### To display turning axes for a part

In the Geometric Cost Drivers pane, expand the Component node (click on the + icon), then click the Turning Axes node. All turning axes for the part will be displayed.


To display individual turning axes, you can click on each distinct turning axis listed under the Turning Axes node.

## Defining stock form and alignment for the Stock Machining and Bar & Tube process groups

aPriori analyzes the geometry of a part and automatically chooses the optimal stock shape and alignment. You can display the automatically-chosen stock shape and alignment and override it using the Stock Form and Alignment tool  in the Component Viewer tool bar. This tool is available only for the Stock Machining and Bar & Tube process groups. The available options and capabilities differ slightly between the two process groups, as described below.

For more information, see the sections "Stock Machining" and "User Inputs for Machining" in the aPriori *Cost Model Guide*.

### To define stock form and alignment manually

- 1 Click the Stock alignment tool  in the Component Viewer tool bar.  
The Stock Form and Alignment window is displayed, with several options to give you control over the stock form and how it aligns with the part.
- 2 Specify the material stock form, using the drop-down menu choices:
  - **Let aPriori Decide** – this menu option is selected by default indicating that stock form and alignment is automatically determined by aPriori. The stock form chosen by aPriori is displayed in parentheses following the field.

- **Round Bar, Square Bar, Rectangular Bar, Round Tube, Square Tube\*, Rectangular Tube\*, Channel Bar\*, Angle Bar\*, Hex Bar\* or I-Beam\*** – if the actual part stock is of a different form than that chosen by aPriori, select it from the menu.

\* Square Tube, Rectangular Tube, Channel Bar, Angle Bar, Hex Bar, and I-Beam stock forms are available only in Bar & Tube Fabrication; they are not supported in Stock Machining.

In Bar & Tube Fabrication, the selected stock form must be similar in shape and size to the finished part, otherwise aPriori will display the message "aPriori cannot find the requested stock form for this part". For example, for a turned part, aPriori supports selection of a round bar or round tube. However, if you select a square bar, aPriori will display the error message. This is because Bar & Tube Fabrication is intended to model the cost of fabricating parts from "as-supplied" stock forms, without the need for additional rough machining around the part boundaries.

In the Stock Machining process group, you may select stock forms that do not closely match geometry of the part, since general rough machining is supported.


- 3 Specify the stock axis/alignment direction** - this is an optional field that allows you to indicate how the part is aligned with the stock axis. Typically, you will not need to use this field, as aPriori will analyze the part from multiple directions and determine which direction and stock form are viable. But in some cases, a part potentially could be made from more than one stock form, depending on what is assumed to be the stock-axis direction.

To change this assumption in Bar & Tube Fabrication, click the Pick button and then click on an edge of the part this is parallel to the desired stock axis. As you move the mouse cursor over the part edges, the edges are highlighted. Highlight the edge along which you want to align the stock and click the left mouse button. Use the Clear button to revert to the stock alignment direction automatically determined by aPriori.


To change this assumption in Stock Machining, click the Pick button and then select either an edge of the part or an axis of the part parallel to the desired stock axis direction, or a planar face on the part that is perpendicular to the desired stock axis direction. As you move the mouse cursor over the part edges or faces, they are highlighted in yellow; as you move them over available setup and turning axes (shown in gray), the axis arrow highlights and a dotted red line is displayed in the axis direction. Highlight the desired item, then click the left mouse button. Use the Clear button to revert to the stock alignment direction automatically determined by aPriori.

- 4 Show Cross Section** - Check this checkbox to show the stock material cross section superimposed against the part and display information about the stock shape and dimensions in the lower right corner of the Viewer pane.

## Defining draw direction for casting and injection molding

The draw direction indicates the direction in which the part mold will be opened. aPriori selects draw direction automatically. To manually select draw direction, use the Draw direction tool  in the Component Viewer tool bar. This tool is available only for Casting and Injection Molding Process Groups.

## To define draw direction manually


- 1 Click the Draw direction tool  in the Component Viewer tool bar.
  - The following things change in the Component Viewer:
    - The mouse cursor turns into the Draw direction tool icon.
    - The part's datum planes are displayed.
    - The suggested draw direction is displayed.
    - The Draw direction options selection box is displayed.
- 2 You can select the following options:
  - **aP Select (Auto)** – This option button is selected by default indicating that draw direction is automatically determined by aPriori.
  - **User Select** – This option button indicates that draw direction is selected manually by you.
  - **Show Parting Line** – Check this checkbox to show the mold parting line.
  - **Advanced/Simple** – By default you define draw direction in Simple mode with the **Advanced** button available. As you move your mouse over GCDs (planar surfaces, holes, curved walls, or the default datums) the proposed draw direction is shown as an arrow on the window. Selecting a GCD changes the draw direction.

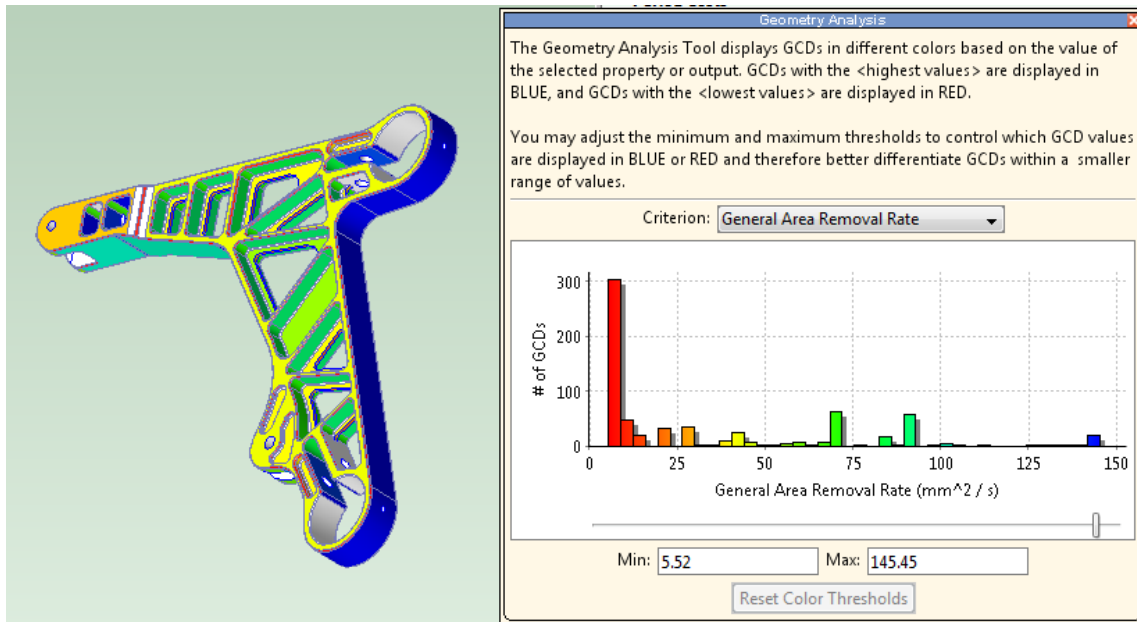
If no suitable planar surface or hole is available to define a draw direction, click the **Advanced** button to define draw direction in spherical coordinate system. The values for **Azimuth** and **Zenith** for the parting line set by aPriori are displayed. To enter new values, do one of the following.

- Click **Select**. As you move the cursor over the component, the **Azimuth** and **Zenith** values change. Click the left mouse button to select new values.
  - Use the up and down arrows in the Azimuth and Zenith fields to change the values or type in the new values.
- 3 Click **Apply** to set the new parting line. Click the **Simple** button to return to the Simple mode.
  - 4 As you move the mouse cursor over the part, the axis, straight edges, datum planes, and flat surfaces that you can use to draw direction are highlighted. The suggested draw direction is displayed for the highlighted item. Highlight the item that you want to use as draw direction and click the left mouse button.

## Working with the Heat Map (Geometry Analysis)

If you have costed your part with the Stock Machining process group, you can direct aPriori to display your part in the Component Viewer in the form of a heat map. Each of the part's GCDs is filled in with a color that indicates the value range, for the GCD, of a specified metric.

To enable the heat map, click the Geometry Analysis tool, , in the Component Viewer tool bar. Your part is displayed as a heat map, and the Geometry Analysis bar graph appears.



The bar graph includes a dropdown menu, labelled **Criterion**, which lists the heat map metrics. If you select, for example, the metric General Area Removal Rate, each GCD in the heat map is filled in with a color that indicates the rate of removal for finishing operations assigned to that GCD. If more than one finishing operation is assigned to the GCD, the color indicates the average rate across operations. Warmer colors (like orange and red) indicate higher values; cooler colors (like green and blue) indicate lower values.

You can enter values into the **Min** and **Max** fields to adjust the colors used to display the range of values. Click **Reset Color Thresholds** to restore the default color spectrum for the component.

The Design to Cost Tool for Machined Parts (introduced in Release 16.2 – see Validation and Design to Cost ) presents the same types of machinability issues as the Heat Map, but in a format that is more user-friendly for casual users who are not experts in machining.

**Note:** Release 16.2 introduces the capability for aPriori System Administrators to configure and customize the heat map Criterion menu. See the aPriori *System Administration Guide*, “Configuring the Geometry Analysis Tool (Heat Map)” chapter.

The Criterion menu is divided into several categories, with each category containing several specific criteria. Remember, these criteria (with the exception of Cycle Time) only generate heat map results if your current component has been costed in the Stock Machining process group.

### Cycle Time & Removal Rate

- **Contouring Removal Rate:** rate at which the contouring operation for the indicated GCD removes material from the GCD’s surface, in unit area per unit time. Removal rate depends on feed, speed, tool diameter, and contact width. Cycle

time increases as removal rate decreases—see “Operation Cycle Time and Cut Time Calculations” in the *Cost Model Guide*.

If the heat map indicates that removal rate for a GCD or group of GCDs is lower than you think it should be, consider making one or more of the following adjustments:

- Increase feed for the GCD(s). See **Requested Feed per Tooth** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Increase speed for the GCD(s). See **Requested Tool Cutting Speed** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify the tool diameter. A larger tool diameter can increase removal rate, but it can also decrease corner accessibility, rendering certain operations infeasible. A smaller tool diameter can sometimes make a more efficient operation feasible. See **Requested Tool Diameter** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify operation assignment, either by directly assigning an operation to the GCD(s), or else by modifying setups or thresholds. See “Modifying Machining Operation Assignments” in the *Cost Model Guide*.
- **Cutting Speed Reduction Factor:** percentage by which the recommended speed is reduced due to limitations of the current machine. aPriori reduces the speed used for calculating removal rate, when aPriori’s recommended speed exceeds the machine’s speed capabilities. If the heat map indicates that the reduction factor is high, consider explicitly selecting a machine that supports higher speeds.
- **Cycle Time:** time to perform the assigned operation on the indicated GCD. For example, if you want to understand which GCDs have the longest cycle times for a machined component, select this option to display GCDs with the fastest cycle time in blue (a faster cycle time results in a lower production cost), and those with the longest cycle times in red. If the heat map indicates that the cycle time is high, examine other metrics for the indicated GCD, such as removal rate and tool diameter, or consider modifying operation assignment.

**Note:** **Cycle Time** is the one criterion that can be displayed for process groups other than Stock Machining.

- **Facing Area Removal Rate:** rate at which the facing operation for the indicated GCD removes material from the GCD’s surface, in unit area per unit time. Removal rate depends on feed, speed, tool diameter, tool path, and contact width. Cycle time increases as removal rate decreases—see “Operation Cycle Time and Cut Time Calculations” in the *Cost Model Guide*.

If the heat map indicates that removal rate for a GCD or group of GCDs is lower than you think it should be, consider making one or more of the following adjustments:

- Increase feed for the GCD(s). See **Requested Feed per Tooth** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Increase speed for the GCD(s). See **Requested Tool Cutting Speed** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify the tool diameter. A larger tool diameter can increase removal rate, but it can also decrease corner accessibility, rendering certain operations infeasible. A smaller tool diameter can sometimes make a more efficient

- operation feasible. See **Requested Tool Diameter** in in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify operation assignment, either by directly assigning an operation to the GCD(s), or else by modifying setups or thresholds. See “Modifying Machining Operation Assignments” in the *Cost Model Guide*.
- **General Area Removal Rate:** rate at which the finishing operation for the indicated GCD removes material from the GCD’s surface, in unit area per unit time. Removal rate depends on feed, speed, tool diameter, and contact width. Cycle time increases as removal rate decreases—see “Operation Cycle Time and Cut Time Calculations” in the *Cost Model Guide*.

If the heat map indicates that removal rate for a GCD or group of GCDs is lower than you think it should be, consider making one or more of the following adjustments:

- Increase feed for the GCD(s). See **Requested Feed per Tooth** in in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Increase speed for the GCD(s). See **Requested Tool Cutting Speed** in in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify the tool diameter. A larger tool diameter can increase removal rate, but it can also decrease corner accessibility, rendering certain operations infeasible. A smaller tool diameter can sometimes make a more efficient operation feasible. See **Requested Tool Diameter** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify operation assignment, either by directly assigning an operation to the GCD(s), or else by modifying setups or thresholds. See “Modifying Machining Operation Assignments” in the *Cost Model Guide*.
- **General Volume Removal Rate:** rate at which the hole-making operation for the indicated GCD removes material from the part, in unit volume per unit time. Removal rate depends on feed and speed. Cycle time increases as removal rate decreases. If the heat map indicates that removal rate for a GCD or group of GCDs is lower than you think it should be, consider increasing feed or speed. See **Requested Feed per Tooth** and **Requested Tool Cutting Speed** in in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- **Side Mill Area Removal Rate:** rate at which the side milling operation for the indicated GCD removes material from the GCD’s surface, in unit area per unit time. Removal rate depends on feed, speed, tool diameter, and contact width. Cycle time increases as removal rate decreases—see “Operation Cycle Time and Cut Time Calculations” in the *Cost Model Guide*.

If the heat map indicates that removal rate for a GCD or group of GCDs is lower than you think it should be, consider making one or more of the following adjustments:

- Increase feed for the GCD(s). See **Requested Feed per Tooth** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Increase speed for the GCD(s). See **Requested Tool Cutting Speed** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify the tool diameter. A larger tool diameter can increase removal rate, but it can also decrease corner accessibility, rendering certain operations infeasible. A smaller tool diameter can sometimes make a more efficient

- operation feasible. See **Requested Tool Diameter** in “Surface Finishing Milling Options” in the *Cost Model Guide*.
- Modify operation assignment, either by directly assigning an operation to the GCD(s), or else by modifying setups or thresholds. See “Modifying Machining Operation Assignments” in the *Cost Model Guide*.
- **Surface Finishing Tool Diameter:** diameter of the tool selected for the assigned operation on the indicated GCD. If the heat map indicates that this value is too small for a GCD or group of GCDs, consider increasing tool diameter, either directly with a process setup option (See **Requested Tool Diameter** in “Machining Node Process Setup Options” in the *Cost Model Guide*. ) or indirectly by activating a setup that provides a better angle on the GCDs corners.
- **Time Tool Machines Air:** percentage of engagement time that is non-chipmaking time, that is, percentage of time during which the tool is engaged (spinning) that the tool is not in contact with the GCD surface (see “Operation Cycle Time and Cut Time Calculations” in the *Cost Model Guide*). If the heat map indicates that this metric is too high, consider reducing tool diameter—see **Requested Tool Diameter** in “Surface Finishing Milling Options” in the *Cost Model Guide*.

## Design Standards

- **Concave Surfaces < Radius Threshold:** This metric quickly show all "small" concave curved walls and surfaces that likely need to be filleted and indicates whether a range of fillet sizes is used rather than some consistent sizes that would reduce tool count and tool change time. In out-of-box VPEs, the Radius Threshold is set to 12% of (Part Height + Part Width), which is a typical rule of thumb for the max tool diameter.
- **Fillet Radii:** The x-axis shows each distinct fillet radius value found in the part; bar height = count of hole GCDs with that value.
- **Hole Diameter:** The x-axis shows each distinct hole diameter value found in the part for simple and multi-step holes; bar height = count of hole GCDs with that value.
- **Non-Standard Fillet Size:** The x-axis shows each distinct NON-STANDARD fillet size value found in the part; bar height = count of fillet GCDs with that fillet value.
- **Non-Standard Hole Size:** The x-axis shows each distinct NON-STANDARD hole diameter value found in the part; bar height = count of Hole GCDs with that diameter value.
- **Side Mill Length to Diameter Ratio:** Tool length divided tool diameter. This ratio affects side-milling feasibility. See “Working with Features to Review” in the *Cost Model Guide*.

If side milling would be appropriate, but the heat map indicates that this value is too small for side milling, check the PSO information entries to see if this caused side milling to be infeasible. If so, you can assign side milling either explicitly or by changing thresholds or setup axes. See **Easy Side Milling Length to Diameter Ratio** and **Maximum Side Milling Length to Diameter Ratio** in “Machining Node Process Setup Options” in the *Cost Model Guide*.

- **Standard Fillet Size:** The x-axis shows each distinct STANDARD fillet size value found in the part; bar height = count of fillet GCDs with that fillet value.



- **Standard Hole Size:** The x-axis shows each distinct STANDARD hole diameter value found in the part; bar height = count of Hole GCDs with that diameter value.

## Issues

- **Contour Milled Corner:** Surfaces with the corner adjacent to a spherical fillet (or toroidal fillet), such that the corner must be contour-milled vs. faced or side-milled like the rest of the surface. This can be machined; it just requires a contouring operation to finish the corner of the surface.
- **Features to Review:** Applies to features that have been assigned to Features to Review or General Mill Finishing. Note that the labels in this view correspond to the “Machining Issues” listed in the Design to Cost (DTC) tab. See “Working with Features to Review” in the *Cost Model Guide*.
- **Obstructed Holes:** The x axis shows a distinct tick for each type of obstructed hole/obstructed hole making op-type (if more than one), otherwise just one tick. Bar height = count of surface GCDs of that type. Bar height = count of surface GCDs of that type.
- **Obstructed Surfaces:** The x-axis shows a distinct tick for each type of obstructed surface/obstructed op type, e.g. Obstructed-No Op Assigned, Facing + Contouring, Facing + Side Milling, etc. Bar height = count of surface GCDs of that type.
- **Sharp Internal Corner:** This displays two types of issues. The first is sharp wall corners, where there is a missing radius between the wall and its adjacent neighbor, such that a side-mill can't reach into the corner. The second is sharp floor corners, where the floor surface is adjacent to a sharp wall corner situation such that a face-mill can't reach into the corner. Neither of these can be machined with a cylindrical tool.

## Machining Technique

- **Finish Milling Operation Type:** The x axis shows a distinct tick for each type of finishing operation, e.g. Facing, Facing + Contouring, Facing + Corner Picking, Side-Milling, Flank-Milling, Contouring, etc. The bar height = count of surface GCDs assigned that type of operation
- **Multi-Approach Operation:** Identifies any GCDs that require a multi-approach operation to complete machining.
- **Special Finishing Operations:** The x- axis shows a distinct tick for each type of specialized finishing operation, e.g. Surface Grinding, Circular Grinding, Reaming, Honing, etc.

## Tolerances

In general, the tolerance and roughness criteria show the effects of the various tolerance settings on geometric cost drivers. For example, surface tolerances show the permissible variation in a surface by displaying the GCDs with the highest (“loosest”) tolerance values in blue, and those with the lowest (“tightest”) values in red. Tightly-toleranced features generally take longer to machine and therefore cost more. Likewise, roughness criteria show the permissible texture of a surface and which surfaces are

more or less expensive to machine. Position and diameter tolerances for hole GCD highlight the permissible variation in these criteria and their relative cost impact.

See [Specifying or importing tolerance and roughness values](#) for details about specifying tolerances in aPriori.

## Using component viewer commands

Right-click anywhere in the Component Viewer to access the Component Viewer Commands. The commands apply to the selected GCD or the selected part.

The following commands are available when selecting parts in an assembly:

- **Initialize:** Initializes the selected parts or assemblies. Every part in the selection is initialized to the same process group, VPE and production settings.
- **Open...:** Opens the selected part in a new tab. This option is available only if just a single part is selected.
- **Save:** Saves any changes in the selected parts or assemblies.
- The following commands are available when selecting a GCD (in both part and assembly views):
- **Edit...:** Opens the Geometric Cost Driver Editor for the highlighted GCD. If no GCD is highlighted, this command is unavailable.
- **Remove:** Deletes the selected virtual welds or user created setup axes.
- **Edit Tolerances...:** Opens the Tolerance Editor for the highlighted GCD. If no GCD is highlighted, this command is unavailable.
- **Auto-merge:** Auto-merges an unmerged ComboVoid GCD. Available only for ComboVoid GCDs that have been unmerged using the **Unmerge** command below.
- **Unmerge:** Unmerges a SimpleHole or a MultiStepHole GCD from a Void GCD in a ComboVoid GCD.
- **Viewer:** Opens the list of the Component Viewer controls.
- **Tools:** Opens the list of the Component Viewer tools. Different tools are available depending on the Primary Process Group.

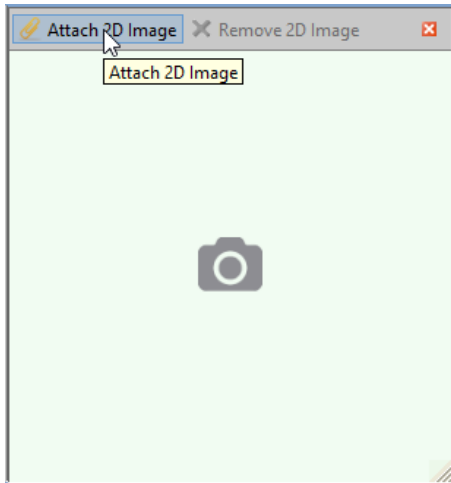
## Specifying 2D Images for virtual components

*(This functionality is available in aPriori 2014 R1 SP1 and later.)* If you have a virtual part or assembly scenario that is not locked, and that does not have a 3D image extracted from a CAD model, you can specify a static image file that will be associated with the component and displayed in the viewer area. You can specify this image file when you define the virtual component, or you can specify it later in the viewer area.

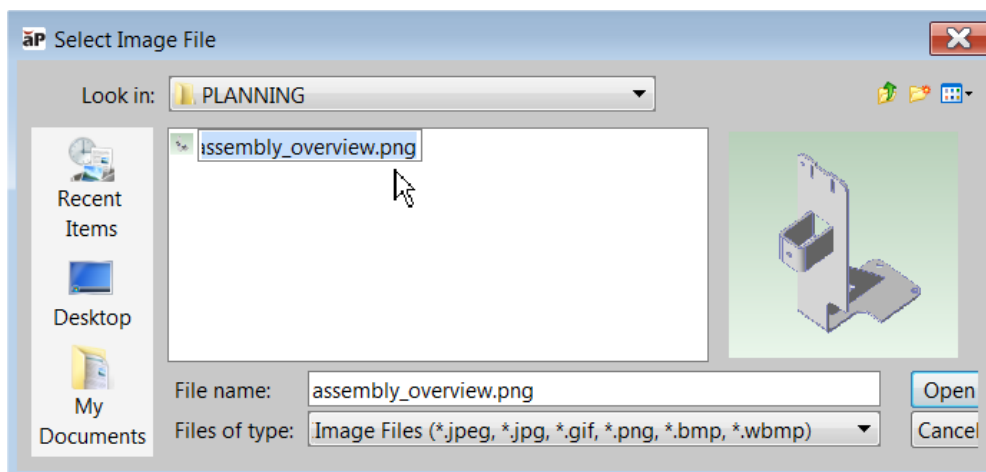
**Note:** In mixed-client deployments, images specified with a 2014 R1 SP1 client may not appear in the viewer of a 2014 R1 client, even though it is visible in the **Search** window.

## To specify or change an image from the viewer

- 1 Click the **Attach 2D Image** icon in the upper-left corner of the viewer. (If no image is currently specified, the viewer displays a gray camera icon.)



- 2 Use the **Select Image File** dialog to navigate to the image file that you wish to associate with the component. Supported image formats are BMP, WBMP, JPG, JPEG, PNG, and GIF.



You can use the same procedure to change image files if necessary.

**Note:** You can also associate image files with CAD-less components when you define the component, or through the Bulk Loader or BOM. You can also attach or delete an image using **Scenario > Attach 2D Image** and **Scenario > Remove 2D image**.

## Controlling the resolution of the Component Viewer

By default, the resolution of the Component Viewer (and of **Tools > Copy Image**) is 600 x 600 pixels. This is typically sufficient for users to view small GCDs, and to read GCD labels when displayed using the **Show GCD labels** command in the Analysis tool. If you prefer a different default resolution, you can change it by adding the following line:

```
apriori.display.copyImageToClipboard.ImageHeight = <n>
```

to the following file:

```
C:\Users\<user>\AppData\Local\apriori\<version>\apriori.user.properties
```

where:

<n> is the number of pixels in the height and width of the image

<user> is the Windows username of the current user

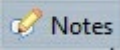
<version> is the aPriori version number.

## Controlling the colors of the Component Viewer

By default, aPriori uses yellow and magenta to highlight selected surface and volumetric GCDs. CAD models that are colored similarly to aPriori highlighting colors are displayed in shades of gray in aPriori instead of their original color. Your system administrator can configure the thresholds at which component colors are considered “too similar” to aPriori highlighting colors. See the aPriori Professional *System Administration Guide* for more details.

## Collaboration and Usability

As of Releases 2016 R2 and 2017 R1, aPriori Professional has added a number of new fields and features that can be used to better manage the process of preparing and refining a cost estimate, and to facilitate collaboration between multiple users. These features are reflected in Cost Insight Design.

- Scenario Notes – The Notes toolbar button () opens a Scenario Notes dialog through which users can enter and save text notes. The Notes field is intended to support collaboration between different users working on the same scenario. As users work with a scenario, they can add notes about decisions, changes, or any questions regarding the scenario. Other users -- both in aPriori Professional and Cost Insight Design -- then can access the notes and respond as appropriate. Notes can be saved without requiring the part to be re-costed.
- Assignee -- Each scenario has an attribute called **Assignee**, providing a way to assign cost estimation tasks to individual users. This field is available both in the **Cost Guide** and the **Administrative Info** dialog. You may select the Assignee from a drop-down list of aPriori users at your company. To find scenarios assigned to yourself or other users, select File→Open to invoke the Search dialog and enter the desired username in the Assignee field. Alternately, you can make a Dynamic Roll Up which will return all scenarios assigned to the user of interest. The assignee field can be updated and saved without re-costing.

- A **Last Assigned Time** field also is available, but this field currently is not updated automatically. You can manually edit the time stamp when changing the Assignee field, if you wish to track when the assignee changed. aPriori plans to populate this time stamp field automatically when the Assignee value is changed in a future release.
- **Status** and **Cost Maturity** – these two fields allow a user to indicate the current state of a scenario, which can be used for tracking and reporting purposes or to implement a basic collaboration process for reviewing and refining cost estimates as design, manufacturing, and sourcing decisions are made. These fields are available both in the **Cost Guide** and the **Administrative Info** dialog. In Release 2017 R1 the possible values of these fields are hardcoded but will be configurable in a future release. Status currently can be left blank or set to New, (Under)Analysis, Waiting, Complete, or Closed. Cost Maturity currently can be left blank or set to Initial, Low, Medium, or High. The Status and Cost Maturity fields can be updated and saved without re-costing.

## Using roll-ups

An aPriori roll-up is a set of components — parts, virtual parts, assemblies, or other roll-ups. A roll-up is similar to an assembly; however, unlike an assembly, a roll-up:

- Can include other roll-ups
- Has no associated CAD component and process costs
- Can include functional groups consisting of nested roll-ups

**Note:** Roll-up subcomponents are not CAD-connected and therefore cannot fetch new GCDs. This means that you cannot change GCD-related settings such as the progress group for a subcomponent, unless it is also open in its own tab. This only applies to roll-ups – subcomponents of assemblies can be CAD-connected.

## Creating and editing roll-ups

Roll-ups are created with a unique name and VPE. The VPE determines the base currency for the roll-up. For more information on VPEs, see *Selecting a virtual production environment (VPE)* on page 174.

### To create a roll-up

- 1 Select **File > New Roll-up**. The New Roll-up window is displayed.
- 2 Enter the **Name** for the new roll-up.
- 3 To accept the default scenario name for the new roll-up, proceed to the next step. If you want to create a scenario with a different name, enter it in the “**Scenario name:**” field. Note that the “**Scenario name:**” field cannot be blank. For more information about scenarios, see *Working with scenarios* on page 66.
- 4 Click **OK**. An empty roll-up is displayed. The roll-up is also added to the Open Items tab in the navigation pane.

## To add a component to a roll-up

- 1 Double-click the roll-up in the navigation pane.
- 2 Add components to the roll-up by:
  - Dragging a component from the navigation pane to the roll-up. The Choose Action window is displayed. Select **Add to Roll-up** and click **OK**.
  - Selecting **Edit > Add > Component(s)** to display the Search window. Enter search criteria in the filter fields and click **Find**. The list of components that match the filter criteria is displayed. Select the component(s) from the list and click **OK**. The official scenario for each component in an assembly is used for costing by default. To use a different scenario for costing, select that specific scenario, rather than the part itself, in the Search window. For more information, see *Using the Search tool on page 37*.
  - Selecting **Edit > Add > New**. You can create and add either a new part, assembly, or roll-up to the active roll-up on the fly. The new component is added to the bottom of the list of roll-up components.
  - Right-clicking an existing roll-up within the active roll-up and selecting **Add > Component(s)** or **New** to access the same menus described in the previous two bullets. The existing or new components are added to the selected roll-up.

The **Status** column shows the status of a component's costing:

- Green — costing completed successfully
- Yellow — costing succeeded with a warning
- Red — costing failed
- Asterisk (\*) — unsaved changes; to save the changes, right-click the component and select **Save**

As soon as you add a component to a roll-up, the roll-up shows in the Roll-ups subfolder of the Where Used folder for this component.

## To copy a roll-up table

- 1 Double-click a roll-up in the navigation pane.
- 2 In the roll-up tab, select **Edit > Copy Table**. The table is copied to the clipboard. You can paste the table into another application such as Microsoft Excel.

## To define roll-up properties

- 1 Double-click a roll-up in the navigation pane.
- 2 In the roll-up tab, select **Edit > Properties**. The Property Editor is displayed.
- 3 You can edit the following properties:
  - Enter a description for the roll-up in the **Description** field.
  - Uncheck the **No Cost Target** checkbox and enter the target cost for the roll-up in the **Roll-up Target Cost** field.

- Select the department that produced the roll-up from the **Source** drop-down list.
  - Select the level of cost estimate from the **Level** drop-down list.
- 4 You can edit the following VPE information:
    - To select a user-defined VPE, check the **User-Defined** checkbox, enter the VPE name in the **VPE** field and select **VPE Type** and **VPE Currency**.
    - To use a pre-defined VPE, clear the **User-Defined** checkbox and select a VPE from the **VPE** drop-down list. **VPE Type** and **VPE Currency** are filled in automatically.
  - 5 Click **Done**.

### To edit a component quantity for a roll-up

- 1 Double-click a roll-up in the navigation pane.
- 2 Right-click the component you want to edit and select **Edit Quantity**. The Edit Quantity window is displayed.
- 3 Enter new quantity. If you enter 0, the component will be removed from the roll-up.
- 4 Click **OK**. The costs are updated to reflect the new quantity. Red up arrows indicate values that went up, green down arrows indicate values that went down.

### To remove a component from a roll-up

- 1 Double-click a roll-up in the navigation pane.
- 2 Right-click the component you want to delete and do one of the following:
  - Select **Remove**.
  - Select **Edit Quantity** and enter 0.The Confirm Delete window is displayed.
- 3 Click **OK**.

### To edit a roll-up

- 1 Double-click a roll-up in the navigation pane.
- 2 In the roll-up table, select a component and edit the Manufacturing Process as desired. New cost reflecting the changes is calculated. Red up-arrows indicate values that went up, green down-arrows indicate values that went down. An asterisk appears next to the component's name to indicate that there are unsaved changes.
- 3 To save the changes, right-click the component and select **Save**.

### To view last saved values

In the roll-up tab, select **View > Saved Values**. The last saved values for the components are displayed without losing any unsaved changes. You cannot edit the saved values.

### To view current values

In the roll-up tab, select **View > Current Values**. The changes that have been made since the values were saved are displayed. You can continue editing the current values.

### To view roll-up components

Double-click a roll-up component in the roll-up table or in the navigation pane to open it in a new tab.

### To save a roll-up as a scenario

- 1 Right-click a roll-up in the navigation pane and select **Save as Scenario**. The Save As window is displayed.
- 2 Enter the Name and Description (optional) for the new scenario.
- 3 Click **OK**.
- 4 The roll-up is saved as a locked (uneditable) scenario. It captures a static version of the roll-up components and costs for later analysis. Once a scenario is created, it appears in the Scenarios folder in the navigation pane. For more information, see *Working with scenarios* on page 66.

## Cutting, copying, and pasting between roll-ups

You can cut, copy, and paste components from one rollup to a new or existing roll-up. This enables you to quickly create alternative groupings of components for analysis purposes, or to dynamically organize product costs as the product structure evolves.

### To cut or copy a component to another roll-up

- 1 Open a rollup and select one or more components you wish to cut or copy (Ctrl+click to select multiple components).
- 2 Right-click and select **Cut** or **Copy** from the context menu.
- 3 Right-click the destination roll-up in the active roll-up tab or open the destination roll-up tab.
- 4 Right-click and select **Paste** from the context menu.

## Using dynamic roll-ups

An aPriori Dynamic roll-up is similar to a roll-up in that it appears to be a list of parts, virtual parts, and assemblies. However, unlike a roll-up, a Dynamic roll-up cannot contain roll-ups or other Dynamic roll-ups, because the contents of a Dynamic roll-up are determined by saved search terms that enable the list to update over time.



A Dynamic roll-up:

- can include virtual parts
- has no associated CAD component and process costs
- can return different components over time

A Dynamic roll-up allows you to save and reopen a search at any time to review the current results. For example, this can help you track activity associated with particular projects, users, or process groups over the last 30 days, at recurring intervals of your choosing.

Where a roll-up is a fixed list of components that may be edited on a part by part basis, a Dynamic roll-up is a changing (or dynamic) list of components that is determined by fixed search criteria (which also may be edited). See *Creating and editing roll-ups* on page 95.

## Creating and editing dynamic roll-ups

Dynamic roll-ups are created with a unique name and VPE. The VPE determines the base currency for the Dynamic roll-up. However, a Dynamic roll-up can include components from multiple VPEs. For more information on VPEs, see *Selecting a virtual production environment (VPE)* on page 174.

### To create a dynamic roll-up

- 1 Select **File > New Dynamic Roll-up**. The New Dynamic Roll-up window is displayed.
- 2 Enter the **Name** for the new Dynamic roll-up.
- 3 To accept the default scenario name for the new dynamic roll-up, proceed to the next step. If you want to create a scenario with a different name, enter it in the “**Scenario name:**” field. Note that the “**Scenario name:**” field cannot be blank. For more information about scenarios, see *Working with scenarios* on page 66.

**Note:** Dynamic roll-ups cannot have multiple scenarios like parts, assemblies, cost comparisons, and roll-ups do.

- 4 Click **OK**. The **Dynamic Roll-up** window is displayed.

The left-hand column in the Dynamic Roll-up window contains **Dynamic Roll-up Criteria**, which function as search filters. (Search filters are explained in *Using the Search tool* on page 37.)

The **Preview** button executes the search and returns the components found by the entered search criteria.

- 5 Selecting **OK** will create the Dynamic roll-up with the specified search criteria. The roll-up is also added to navigation pane > Open Items > Roll-ups.

### To edit a dynamic roll-up

- 1 Double-click the roll-up in the navigation pane.
- 2 In the Dynamic roll-up tab, select **Edit > Edit Query**.

The **Query Editor** window opens. The Query Editor is identical in function to the **Dynamic Roll-up** window.

- 3 Edit your **Dynamic Roll-up Criteria** to refine your search.
- 4 Preview and select **OK** to return the updated list retrieved by your new criteria.

The **Status** column shows the status of a component's costing:

- Green — costing completed successfully
- Yellow — costing succeeded with a warning
- Red — costing failed
- Asterisk (\*) — unsaved changes; to save the changes, right-click the component and select **Save**

As soon as you add a component to a roll-up, the roll-up shows in the Roll-ups subfolder of the Where Used folder for this component.

### To update dynamic roll-up components

There are two ways to refresh the components returned in an open Dynamic roll-up:

- Close and reopen the Dynamic roll-up
- In the Dynamic roll-up tab, select **Edit > Edit Query** and select **OK** in the **Query Editor**.

### To copy a dynamic roll-up table

- 1 Double-click a Dynamic roll-up in the navigation pane.
- 2 In the roll-up tab, select **Edit > Copy Table**. The table is copied to the clipboard. You can paste the table into another application such as Microsoft Excel.

### To define dynamic roll-up properties

- 1 Double-click a Dynamic roll-up in the navigation pane.
- 2 In the Dynamic roll-up tab, select **Edit > Properties**. The Property Editor is displayed.
- 3 You can edit the following properties:
  - Enter a description for the roll-up in the **Description** field.
  - Uncheck the **No Target Cost** checkbox and enter the target cost for the roll-up in the **Roll-up Target Cost** field.
  - Select the department that produced the roll-up from the **Source** drop-down list.
  - Select the level of cost estimate from the **Level** drop-down list.

- 4 You can edit the following VPE information:

To select a user-defined VPE, check the **User-Defined** checkbox, enter the VPE name in the **VPE** field and select **VPE Type** and **VPE Currency**.

To use a pre-defined VPE, clear the **User-Defined** checkbox and select a VPE from the **VPE** drop-down list. **VPE Type** and **VPE Currency** are filled in automatically.

- 5 Click **Done**.

### To edit a component in a dynamic roll-up

- 1 Double-click a Dynamic roll-up in the navigation pane.
- 2 In the Dynamic roll-up table, select a component and edit the Manufacturing Process as desired. New cost reflecting the changes is calculated. Red up-arrows indicate values that went up, green down-arrows indicate values that went down. An asterisk appears next to the component's name to indicate that there are unsaved changes.
- 3 To save the changes, right-click the component and select **Save**.

### To view last saved values

In the Dynamic roll-up tab, select **View > Saved Values**. The last saved values for the components are displayed without losing any unsaved changes. You cannot edit the saved values.

### To view current values

In the Dynamic roll-up tab, select **View > Current Values**. The changes that have been made since the values were saved are displayed. You can continue editing the current values.

### To view dynamic roll-up components

Double-click a Dynamic roll-up component in the Dynamic roll-up table or in the navigation pane to open it in a new tab.

## Using functional groups

You can create functional groups for roll-ups to organize large product structures that may not be defined in CAD. Functional groups may help you:

- Organize very large product structures for comparison across programs
- Establish the framework for costing dynamic product configurations in very large product structures
- Assign team responsibilities for function costs within a program

Functional groups in a roll-up are just roll-ups created within that roll-up. You can create functional groups one at a time, or you can import a functional group template, which generates the entire functional group structure in one step. For example, if you want to generate consistent functional group structures within multiple roll-ups, you can use your functional group template for multiple roll-ups. For more information on reusing a template, see *Cutting, copying, and pasting between roll-ups* on page 98. Roll-ups can have functional groups applied both through the UI and through the BOM Loader (see the *VPE Administrator Guide*).

The template is an XML file which describes the roll-up hierarchy to be created in the parent roll-up. The hierarchy represents your functional groups. You can create a

template by using the Microsoft Excel spreadsheet `Functional Group Template Generator.xls` in the `install-support\templates` directory of your aPriori installation.

## Reapplying functional groups templates

If you apply a functional group template to a roll-up that has already had it applied, aPriori observes the following rules:

- Any groups that have already been created will be skipped (that is, aPriori will not create a new version or scenario of the existing group).
- Any groups that do not already exist will be created (that is, if additional groups have been added to the template, they will be added to the roll-up).
- Any roll-up groups that do not exist in the template will be ignored (that is, any groups that have been removed from the template will not be removed from the roll-up).

**Note:** Before re-applying a functional group template, please read *Best practices using functional groups* below.

### Functional group naming conventions

aPriori observes the following conventions when displaying roll-ups that have had a functional group template applied to their structure. Note that this behavior has changed as of aPriori Release 2014 R1:

- Roll-ups that were created by applying a functional group template are represented as different roll-ups, not as different scenarios of the same roll-up. The fully qualified name for a functional group is constructed as "`<parent roll-up >. <functional group name>`"
- In the Details table, the Name column shows only the name of the roll-up, not the fully qualified name. For example, a group with the full name "Roll1.drivetrain.engine" will display only "engine".
- In the manufacturing process tree, and in the tab name for an opened scenario, and in the Search dialog, the fully-qualified name is displayed.

### Best practices using functional groups

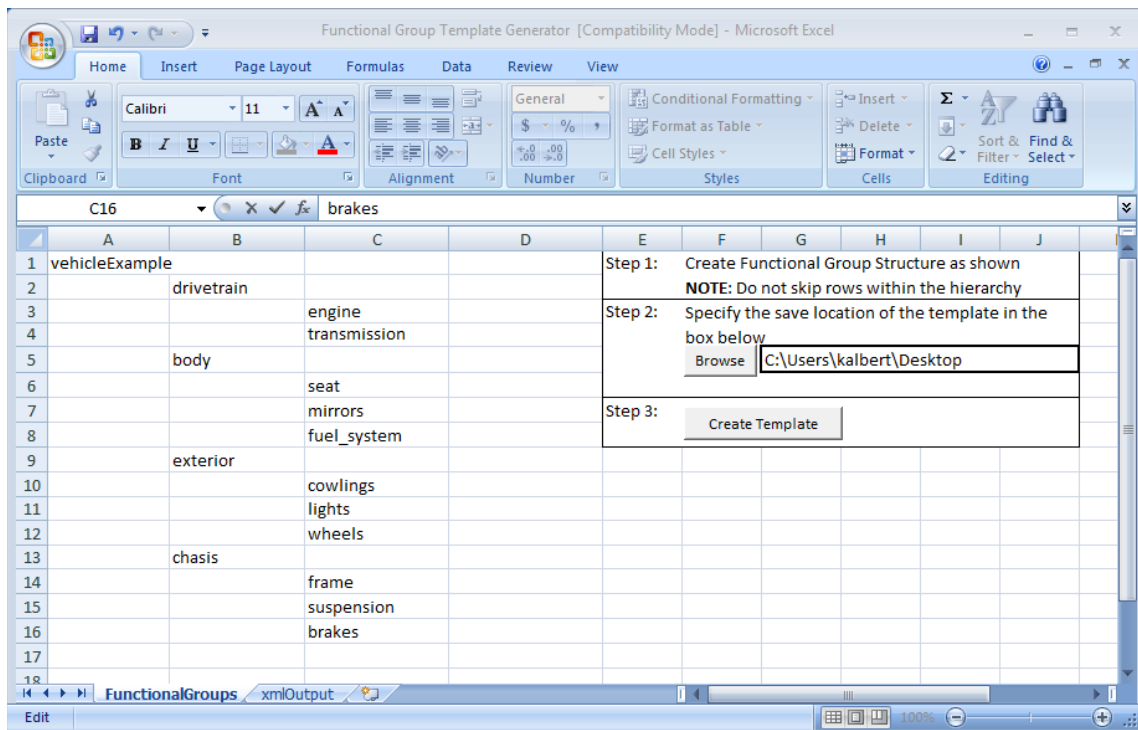
Although you can re-apply a functional group template, aPriori recommends the following practice: if you find that you want to apply a functional group template to a roll-up that already has one (for example, you have updated the functional groups, or you applied the wrong functional group template to the roll-up and now wish to apply the correct one), create a new roll-up instead, and apply the updated or correct functional group template to new roll-up.

#### To create a functional group template

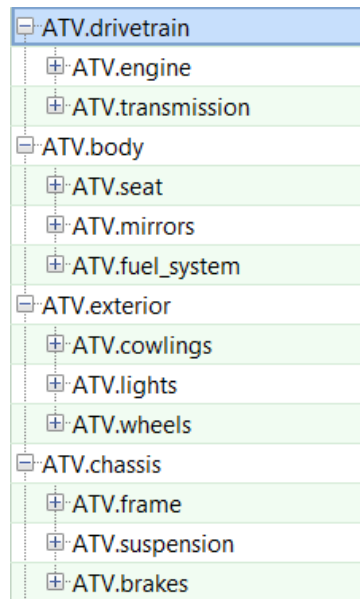
- 1 Open `Functional Group Template Generator.xls` in the `install-support\templates` directory of your aPriori installation.

- 2 Put the name of the functional group hierarchy in cell A1. This is a name of your choosing. It is used in the filename of the generated template.
- 3 Specify the functional group structure as follows:
  - Put names of top-level functional groups in column B.
  - Put each child group in the column immediately to the right of its parent group. Put the first child on the line immediately below (and to the right of) the parent's line. Put any additional children immediately below that.
  - Do not leave entirely blank any row or column that is within the structure specification.
  - Only one cell of each row should be occupied.
  - Insert additional columns as needed.
- 4 Use the spreadsheet's Browse button and/or the text field next to it to enter or navigate to the directory to contain the generated template.
- 5 Click the spreadsheet's Create Template button. The template file is created in the specified directory. The filename is the group name followed by .fgt.XML.
- 6 You can use the spreadsheet's xmlOutput tab to view the generated XML.

Here is an example:



The spreadsheet above generates the following functional group hierarchy:



In this example, the name of the parent roll-up is `ATV`, which precedes the node names of the functional groups that are created.

As an alternative to using the template generator spreadsheet, you can create the XML yourself. Use a format like the following:

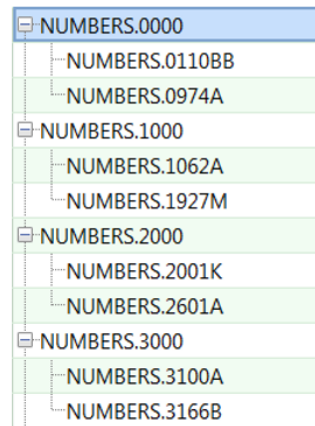
```
<?xml version="1.0" encoding="UTF-8"?>
<vehicleExample>
  <drivetrain>
    <engine/>
    <transmission/>
  </drivetrain>
  <body>
    <seat/>
    <mirrors/>
    <fuel_system/>
  </body>
  <exterior>
    <cowlings/>
    <lights/>
    <wheels/>
  </exterior>
  <chassis>
    <frame/>
    <suspension/>
    <brakes/>
  </chassis>
</vehicleExample>
```

Since XML does not allow numeric element names, use the following type of format to handle numerical functional group names:

```

<?xml version="1.0" encoding="UTF-8"?>
<VehicleExampleNumbers>
  <group name="0000">
    <group name="0110BB"/>
    <group name="0974A"/>
  </group>
  <group name="1000">
    <group name="1062A"/>
    <group name="1927M"/>
  </group>
  <group name="2000">
    <group name="2001K"/>
    <group name="2601A"/>
  </group>
  <group name="3000">
    <group name="3100A"/>
    <group name="3166B"/>
  </group>
</VehicleExampleNumbers>

```



Save the new file with the `.fgt.XML` extension so that aPriori can recognize the file as a functional group template. For example, a valid template filename is `myFunctionalGroups.fgt.XML`. If you are editing with Notepad and do not save the file with this extension, the file will be stored as a text file and aPriori will not be able to import it.

### To create functional groups using a functional group template

- 1 Open a rollup.
- 2 Select **Tools > BOM > Apply Functional Group Template** from the aPriori menu bar.
- 3 Navigate to the location of your functional group template file, select it, and click **Open** to create the structure described within your template in the open roll-up.


## Comparing the costs of alternative designs

aPriori provides the ability to compare different scenarios to identify the costs of alternative designs or manufacturing approaches for a part, an assembly, or a roll-up.

For example, you might cost a sheet metal component with a scenario produced in Mexico and a scenario produced in China. You can add both scenarios to a comparison and analyze the price difference.

### Creating and editing Comparison Summary views

You can create a Comparison Summary from three points in the UI:

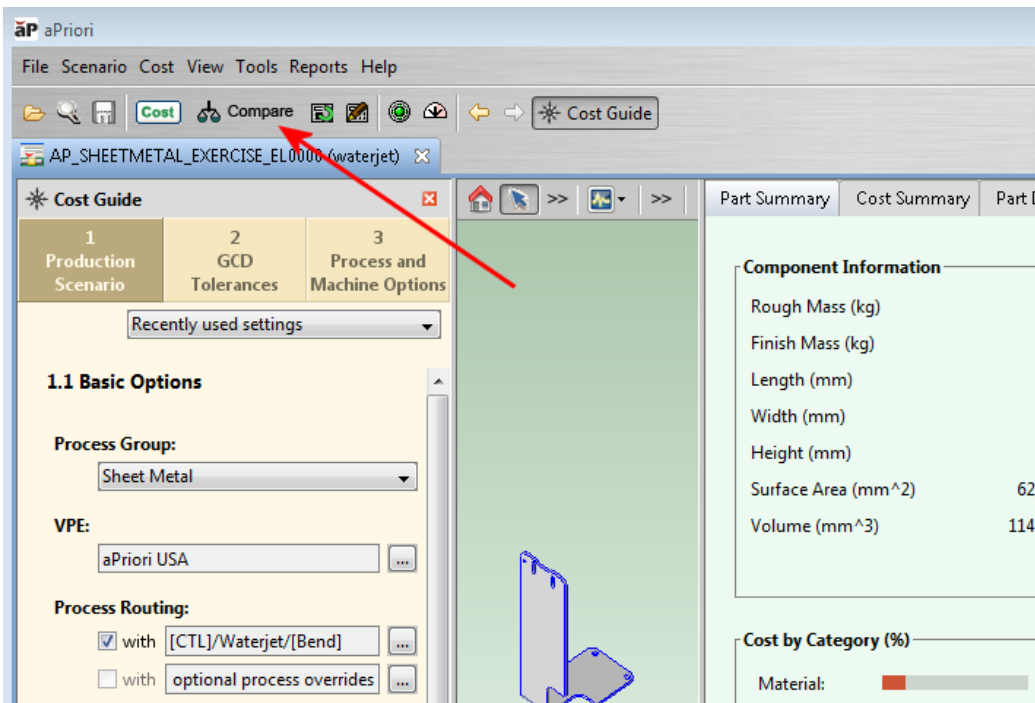
- From the **Compare** button (  Compare ) on the toolbar, which starts with the currently-open scenario and prompts you to specify a second for comparison.

- From the **Scenario > Create Comparison** menu, which behaves identically to the **Compare** button.
- From the **File > New Cost Comparison** menu, which prompts you to specify both scenarios to compare.

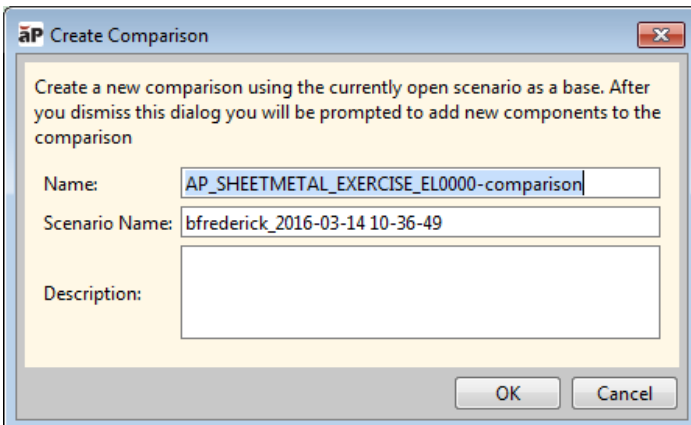
### To create and work with a Comparison

The most common situation is when you are already working with one open scenario and wish to compare it to another scenario.

- 1 Ensure that the first scenario of interest is open and selected.
- 2 Click the **Compare** button from the toolbar. (Alternatively, you can click the **Scenario > Create Comparison** menu.)



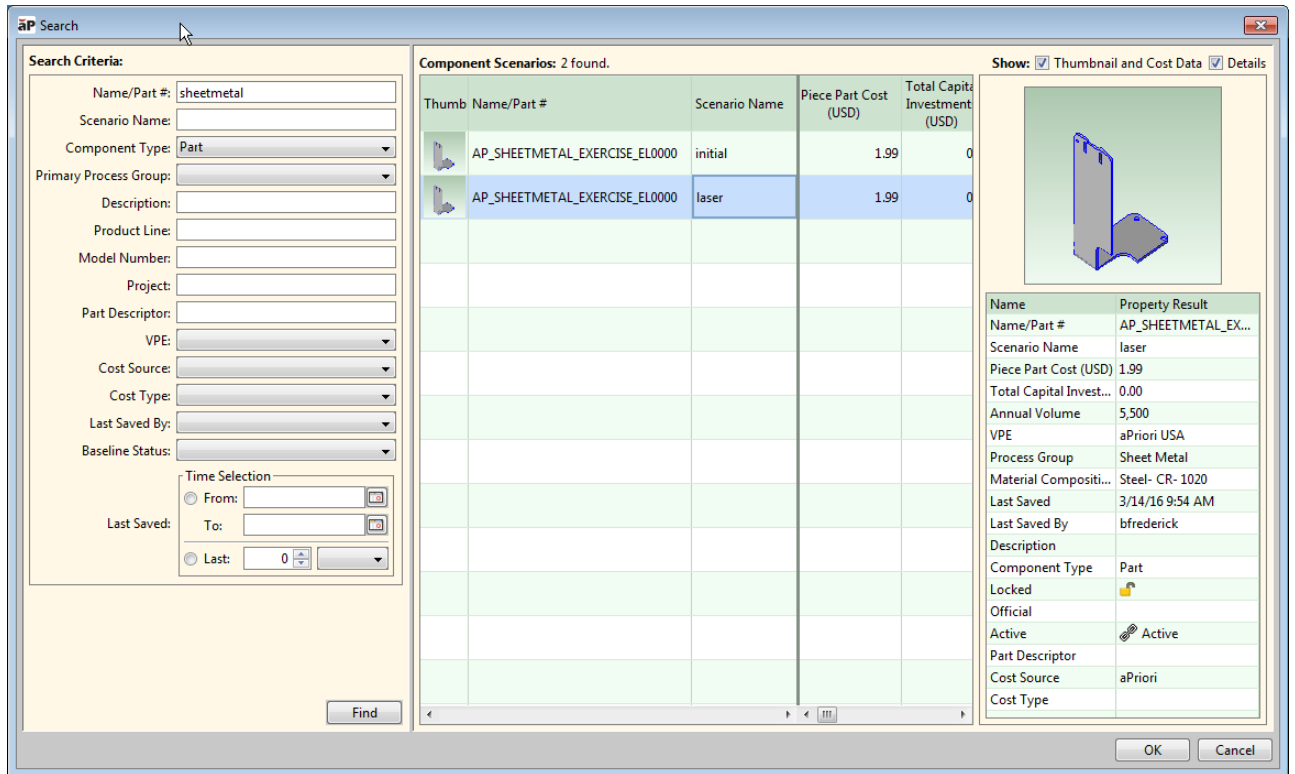
- 3 In the resulting **Create Comparison** dialog, you can optionally edit the **Name:**, **Scenario Name:**, and/or **Description:** fields. Click **OK** when done.





- 4 In the resulting **Search** window, find and select the second scenario which you would like to compare. (For more information about using the Search window, see [Using the Search tool.](#)) Click **OK** when done.

**Note:** You can increase your selection for additional scenarios to compare by using **CTRL-Click** in the **Search** tool..



- 5 In the resulting **Comparison Summary** view, the left-most component is considered the "Base". Any scenarios to the right of the Base scenario are compared to the Base, and variations from the Base are shown in the **%Diff** column.

Name	AP_SHEETMETAL_EXERCISE_EL0000	AP_SHEETMETAL_EXERCISE_EL0000	% Diff
<b>Scenario Details</b>			
Scenario	waterjet	laser	
Cost Object Type	Part	Part	
Description			
Revision			
Target Cost (USD)			
<b>Production Details</b>			
VPE	aPriori USA	aPriori USA	
Process Group	Sheet Metal	Sheet Metal	
Annual Volume	5,500	5,500	0
Batch Size	458	458	0
Production Life (Years)	5.00	5.00	0
Process Routing	Material Stock / Waterjet Cut / Bend Br...	Material Stock / Laser Cut / Bend Brake	
<b>Material Composition</b>			
	Steel- CR- 1020	Steel- CR- 1020	
Material Unit Cost (USD / kg)	0.820	0.820	0
Finish Mass (kg)	n an	n an	0

## 6 In the **Summary** view you can:

- Collapse and expand entries in the **Name** column, using either the "+/-" buttons, or the mouse-over menu in the upper-left corner of the column (see *aPriori Desktop table controls* for more information).
- Add additional scenarios to compare against the Base scenario by clicking **Add** and using the **Search** tool as described above. (There is no practical limit to the number of scenarios you can add.)
- Make a different scenario the Base by selecting its column and clicking the **Set as Base** button.
- Remove a scenario from the comparison by selecting its column and clicking the **Remove** button. (You can expand the selection to remove multiple scenarios at once with **Shift-Click** and **Ctrl-Click**.)
- Open a scenario by selecting its column and clicking the **Open** button.

**Note:** If you recost a scenario, any changes are immediately reflected in the **Comparison Summary** view.

## To save, find, and re-open Comparison Summaries

Comparison summaries can be saved, searched for, and opened as scenarios like any other component.

Use the options on the **Scenario** menu to save comparison summaries and to change their Active, Lock, and

official status.

For more information, see *Working with scenarios* on page 66.

# Creating new components without CAD

You can create a new component even when there is no CAD model from which to derive the cost. A component created without a CAD model is also referred to as a *virtual component* (part or assembly). For example, a virtual component may represent any of the following:

- Component sourced from a supplier
- Non-mechanical component, such as lubricant or packing supplies
- User-defined process, such as inspection or handling
- Early conceptual part, for which a CAD model does not yet exist
- Early conceptual assembly, for which some or all CAD models do not yet exist

Since a virtual component has no CAD model, aPriori cannot automatically derive geometric cost drivers, such as length or volume. However, you can enter some basic geometric information for a virtual component.

A virtual component is assigned to the User Guided process group and that group's default VPE, but the virtual component has no material or process routing by default. A virtual assembly component is assigned to the Assembly process group and that group's default VPE.

The assembly process routing is fully accessible from virtual assemblies, and all components contained within the assembly, virtual or CAD-based, contribute to the aggregate cost of the assembly. Assembly processes also reflect the costs of subcomponent assembly, as long as you provide a mass for each subcomponent.

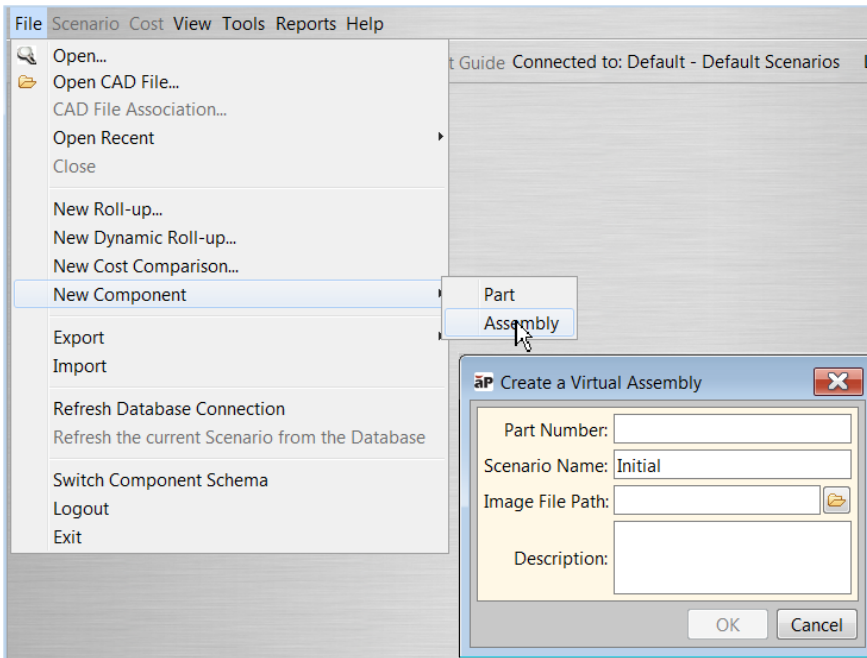
Assembly component geometric cost drivers may be specified in the Geometric Cost Drivers window. Volume, Surface Area, Length, Width and Height may be entered to describe assemblies that are not CAD-based.

There are two ways to generate cost information for virtual parts. You can manually enter data for the individual cost component fields, and the aggregate cost fields, such as Total Variable Costs or Fully Burdened Cost, are computed by aPriori. Or you can use the aPriori User-Guided Costing module (licensed separately) to generate costs using the basic geometric information and other inputs you supply.

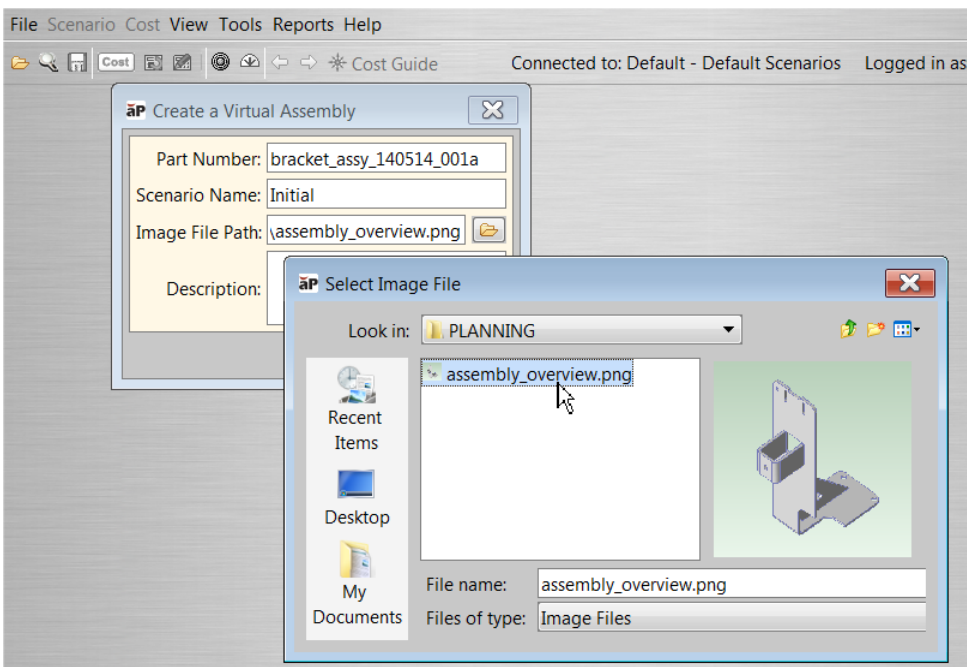
Assembly components that are not CAD-based generate cost information just like CAD-based assembly components. Subcomponent costs are aggregated, and assembly costs are calculated for the active assembly. You can enter cost information for manually costed assemblies, disengaging the aPriori cost engine, and use cost overrides to enter values for the aPriori cost engine. For more information about manual costing, see [Overriding computed values on page 112](#).

## To create a non-CAD-based component

- 1 Select **File > New Component > Part** or **Assembly** from the aPriori menu bar to display the Create a Virtual Part or Create a Virtual Assembly window.



- 2 Enter a part number in the **Part Number** field.
- 3 To accept the default scenario name for the new part or assembly, proceed to the next step. If you want to create a scenario with a different name, enter it in the “**Scenario name:**” field. Note that the “**Scenario name:**” field cannot be blank. For more information about scenarios, see *Working with scenarios* on page 66.
- 4 (Optional, available in 2014 R1 SP1 and later): In **Image File Path:**, click the folder icon to browse to an image that you want associated with the component.



Supported image formats are BMP, WBMP, JPG, JPEG, PNG, and GIF.


- 5 (Optional) Enter a description in the **Description** field.
- 6 Click **OK** to display the Production Info tab of the Cost Object Info window.
- 7 Select the Costing Method:
  - **Manual** to manually enter cost data for the part,
  - **aPriori** if you have licensed the aPriori User Guided Costing module and will be entering inputs to drive a user-guided cost model,
- 8 Select the Batch Size.
  - **Auto** to have aPriori calculate the monthly production size from your **Annual Volume** value/12.
  - **Manual** to provide a specific value.
- 9 (Optional) Check the **Target Cost and /or the Target Finish Mass** box and enter a value in their fields to associate target values with the component.
- 10 Click **OK**.

## Working with non-CAD-based assembly components

Once an assembly component has been created without CAD, you can edit the assembly structure and associated components using commands in the Assembly Details tab.

An assembly may be created independently from CAD and can contain subcomponents based on CAD models as well as subcomponents that are non-CAD-based. You can manually associate new or existing subcomponents to an active assembly regardless of the assembly's association to a CAD model.

You may build around an existing CAD-based assembly, create a new assembly component which incorporates CAD-based assembly and part components, or create an entirely virtual assembly component. However, CAD-based assembly structures cannot be contradicted. That is, you can add subcomponents to a CAD-based assembly, but you cannot remove subcomponents (or change their quantity) in the aPriori assembly component(s) based on a CAD model.

aPriori creates assembly structures automatically from a CAD model. When your assembly is not based on a CAD model you have to create the structure manually in the Assembly Details tab. Each manually associated subcomponent (part or assembly, CAD-based or non-CAD-based) displays  in the Status column.

Virtual assembly structures may also be created using the BOM Loader. For more information, see the *aPriori VPE Administration Guide*.

### To modify an assembly structure

Use the following assembly commands in the Assembly Details tab to create the assembly structure. Right-click a subcomponent within the assembly to display the following options in the context menu:

- **Copy** – Copies the selected subcomponent for pasting
- **Cut** – Removes a manually associated subcomponent from an assembly for pasting
- **Paste** – Inserts cut or copied components to the selected assembly
- **Add > Component(s)** – Displays the Search window, where you can select one or more components to add to the selected assembly
- **Add > New > Part or Assembly** – Displays the Create a Virtual Part or Create a Virtual Assembly window, where you can create a new part or assembly subcomponent
- **Edit Quantity** – Enter a quantity for the selected manually associated subcomponent
- **Remove** – Remove the selected manually associated subcomponent from the assembly

You can also drag and drop a manually associated subcomponent to move it within the assembly structure.

## Overriding computed values

In aPriori Desktop, you can manually specify a component's associated values, overriding the values computed by aPriori using the component's geometric cost drivers (GCDs), non-geometric cost drivers (such as selected routings, production volume, etc.), properties from the CAD file, and VPE data. This is useful for a wide array of situations that call for customization of cost-related factors. For example, you can override the aPriori labor rate data to better match the labor rates quoted by a supplier, for quote validation purposes.

aPriori Desktop provides two kinds of computed-value override:

- **Part details overrides:** overrides values, such as Labor Time, which are presented in the **Part Details** or **Assembly Details** tab. These reflect values for the various processes and operations used to create the component. Overriding a value affects all values that depend on it.
- **Cost summary overrides:** overrides costs, such as Material Cost or Logistics, that are presented in the **Cost Summary** tab of aPriori Desktop. These reflect costs for the entire routing used to create the component (rather than costs for any individual process or operation). See *Performing Part Details overrides* and *Performing total cost summary overrides*.

The **Cost Overrides Summary** dialog (not to be confused with overrides in the **Cost Summary** tab) provides a summary of the various overrides and user inputs that are in effect. See *Working with the Overrides Summary dialog*. To remove overrides, use the **Cost Overrides Summary** dialog.

### A note about Cost Overrides and One Click Costing

In releases of aPriori prior to 2015 R1, entering a Cost Override would automatically cause the component to re-cost, even if One Click Costing was enabled. (See *One Click Costing™ (enabling/disabling auto-costing in response to CAD changes)* for more information about One Click Costing.) This could be very inefficient if you needed to

enter several overrides. In aPriori Release 2015 R1 and later, Cost Overrides entered in the **Part Details**, **Assembly Details**, and **Roll-up** views will not automatically cause a re-cost when One Click Costing is enabled. However, any Cost Overrides entered in the **Cost Summary** tab will still cause an immediate recosting, regardless of the One Click Costing setting.

## Performing Part Details overrides

In the Part Details or Assembly Details views, you can double-click on a table cell in order to override the value of that cell. aPriori dynamically re-calculates any fields that depend on overridden values. For example, if you override either the Labor Rate or Number of Operators for a process, aPriori updates the value of the Labor Cost field for that process accordingly. This update is then propagated to values that depend on it, ultimately affecting the total labor cost for the part.

**Note:** A value depends on another value only if its formula takes the other value as an input. The exact inputs to each value's formula are not always apparent. For example, some formulas for Material Cost (which can be calculated from Part Mass) do not have Part Mass as an input, but rather have both Part Volume and Material Density as inputs. In these cases, Material Cost is *not* affected by an override of Part Mass. The Cost Model Workbench includes detailed information about each formula.

When you override a field value, you can optionally enter a comment to indicate the reason for the override. Editable fields are denoted with a "pencil" icon. Overridden cells are displayed in red font.

Sourcing engineers will find this cost override capability useful when they are trying to validate supplier quotes – they can input their supplier's labor and overhead rates and profit margins, for example, to estimate the expected supplier cost. Manufacturing and cost engineers, with their more in-depth knowledge of manufacturing practices and time standards, might wish to override lower levels of detail, including individual process cycle times.

Generally, it is recommended that you override fields at the specific process level, rather than a higher level of the manufacturing tree. This is because the formulas that define relationships between various fields are generally defined at the process level, so updates to one field will only ripple to other fields if they are applied at that process level. In the example below, aPriori allows you to override the Labor Time field for the Band Saw process, but not for the Saw node above it. The updates will then be properly propagated up to the Saw row.

Cost Object		Cost Descri...	Manufacturing Info		Manufacturing Times				Custom O...
Status	Name	Scenario	Locked	Process Group	Labor Time (s)	Cycle Time (s)	Batch Setup Time (hr)	Parts Per Hour	Output Name
● *	Current	initial		Forging	▼ 297	210	1.17	17.14	
●	Forging				▼ 297	210	1.17		
●	Material Stock				-	-	-		
●	Saw				▼ 89	74	0.17		
●	Band Saw				▼ 89	74	0.17		
●	Preheat				97	75	0.25		
●	Hammer				62	24	0.25		
●	Trim				48	37	0.50		
● *	Previous	initial		Forging	304	210	1.17	17.14	
● *	Last Saved	initial		Forging	304	210	1.17	17.14	

**Notes:** 1. You cannot override the material's Utilization % in the Part Details tab. To override the material utilization, use the Material Selection dialog. See *Selecting material* on 138 for more details.

2. In some cases, overriding a field will not have the expected effect on another field. This can happen if the manufacturing process cost model does not actually have equations defined that relate the second field to the first updated field. Please contact aPriori Support if you have questions about cost overrides and unexpected behavior.

### To enter overrides in the Details tabs

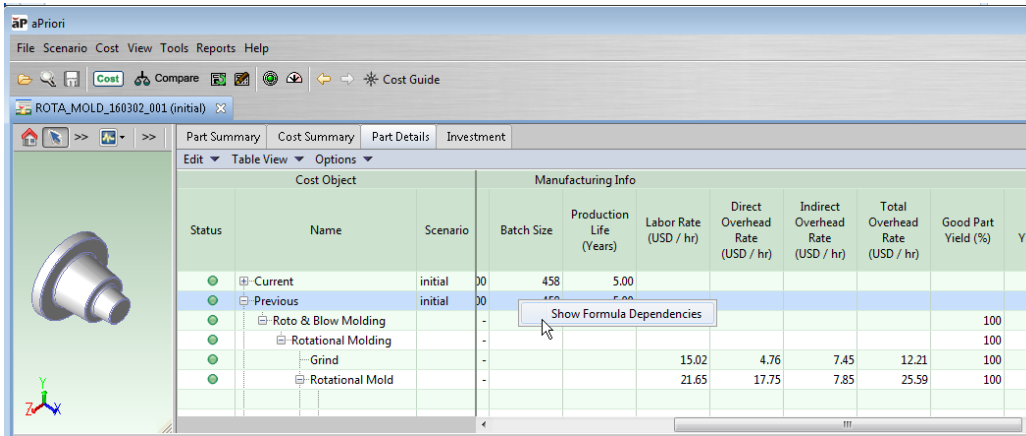
- 1 Double-click a cell with a pencil icon ( ).
- 2 Type the new value followed by **Enter**.

**Note:** When you override a formula, any cells that contribute to that formula display dashes and cannot be overridden.

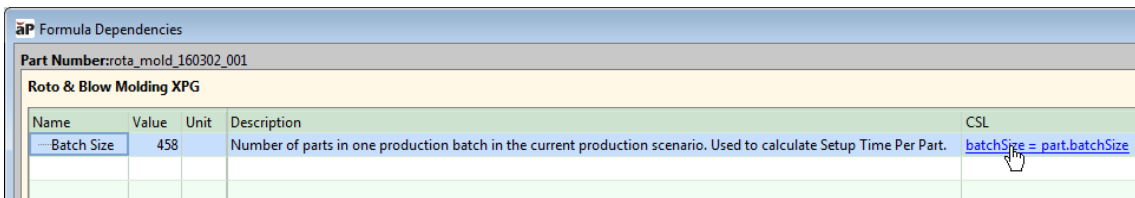


## Show Formula Dependencies

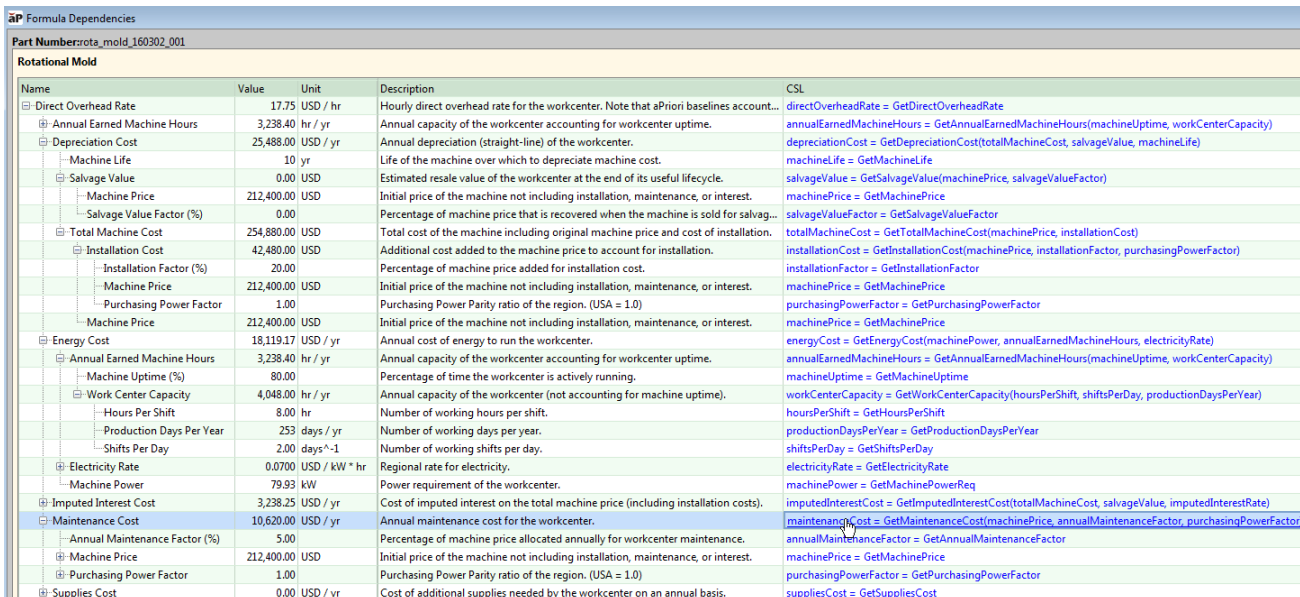
When you right-click a cell in the **Part Details** or **Assembly Details** tab, you are presented with a context menu containing the option **Show Formula Dependencies**.



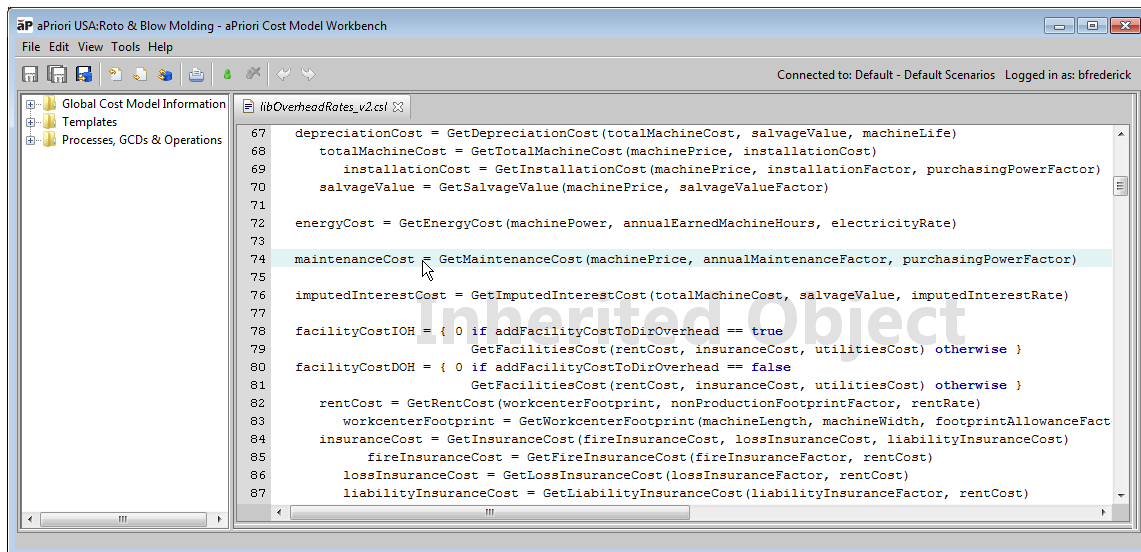
Clicking this displays a window populated with information regarding the value in the cell. For a simple value like "Batch Size", the display might be relatively sparse, with just a description and a link to the CSL code:



For a more complex, calculated value like Direct Overhead Rate, the Formula Dependencies window can display a large amount of information in tree format showing not only the current formula, but also which formulas contribute to it.



Clicking on a formula under the CSL column opens the Cost Model Workbench on the page where that formula is defined:



**Note:** The behavior of **Show Formula Dependencies** can change if you change the mode by which overhead rates are calculated. This mode is controlled by the **Use Computed Overhead Rate** VPE variable (see the section "VPE Variables, Machine Properties, and Overhead Costs" in the *aPriori Cost Model Guide*). When set to **True** (the default for release 2015 R1 and later) **Show Formula Dependencies** displays all direct and indirect overhead rates as computed. If set to **False**, or if you change the VPE to one where this variable is set to **False** (the default mode prior to 2015 R1), **Show Formula Dependencies** will display a value of "0" or any overridden value, even though these formulas are no longer relevant in the costing of the part.

When using Show Formula Dependencies, you should generally select fields from process level or die-station rows, rather than at the process-group or part-level rows. Process-group and part-level rows simply aggregate the rows below, so for most fields the formula dependencies dialog does not provide additional information about the contributors to those formulas. (Formula dependencies are available only for a select number of fields at the part level, listed below). In the example below, a user should select the Labor Time cell at the Turret Press row, not at the Sheet Metal row, to get drill-down visibility into the Labor Time cost model.

Part Summary		Cost Summary		Part Details		Investment			
Edit ▾ Table View ▾ Options ▾									
Cost Object			Manufacturi...	Manufacturi...	Compo...	Material In...	Variable Costs		
Status	Name	Scenario	Annual Volume	Labor Time (s)	Finish Mass (kg)	Material Composit			Total Variable Costs (USD)
● *	Current	Laser	5,500	▼ 27	▲ 0.54	Steel- CR- ...			▲ 1.34
●	Sheet Metal		-	27	0.54				1.34
●	Material Stock		-	☒	0.00				0.00
●	Turret Press		-	☒ 12	0.54				1.20
●	Bend Brake		-	☒				Show Formula Dependencies	0.14
● *	Previous	Laser	5,500		36	0.07	ABS		0.81
● *	Last Saved	Laser	5,500		106	0.54	Steel- CR- ...		1.91

The resulting Formula Dependencies for Turret Press Labor Time is shown below:

**Formula Dependencies**

Part Number: 117-8476\_5MMTHICK

**Turret Press**

Name	Value	Unit	Description
Labor Time	12	s	Paid time for direct labor needed to manufacture the part or assembly. It is a function of the cycle
Cycle Time	10	s	Time for one complete cycle of the applicable machines to make a single part. Cycle time is used
Cycle Time Adjustment Factor	1.00		Factor used to globally increase or decrease cycle time evaluations per process. Used to calculate
Process Time	9.90	s	Time for one complete process of the applicable machines to make a single part. Process time is u
Hits Total	31.00		Sum of total punched, nibbled, and tapped hits. Used for display purposes.
Labor Handling Time	2.00	s	Time for loading a single part onto the machine and unloading it from the machine. Used to calcul
Total Nibbling Time	0.00	s	Time for nibbling operations for selected machine. Used to calculate Process Time.
Total Punch Time	7.75	s	Time for punching operations for selected machine. Used to calculate Punch Time, Process Time.
Total Tapping Time	0.00	s	Time for tapping operations for selected machine. Used to calculate Punch Time, Process Time.
Total Tool Change Time	0.15	s	Total time for tools changing. Used to calculate Process Time.
Labor Time Standard	1.25		Conversion of machine cycle time to labor time while accounting for the inefficiency and downtim
Number of Operators	1.00		Number of operators tending to this machine. A value less than 1 indicates that an operator tends

**Fully Burdened Cost (USD)**  
▼ 1.55 22% Change

Cost Close

Formula Dependencies are provided for the following Process-Level fields:

- Direct Overhead Rate – introduced in aPriori 2015 R1
- Indirect Overhead Rate – introduced in aPriori 2015 R1
- Total Overhead Rate
- Final Yield
- Lifetime Scrap Parts
- Labor Time


- Cycle Time
- Batch Setup Time
- Finish Mass
- Scrap Mass
- Rough Mass
- Utilization
- Material Cost
- Labor Cost
- Direct Overhead Cost
- Amortized Batch Setup
- Logistics
- Material Overhead
- Expendable Tooling
- Additional Direct Costs
- Extra Costs
- Other Direct Costs
- Total Variable Cost
- Indirect Overhead Cost
- SG&A
- Margin
- Piece Part Cost
- Hard Tooling (amortized)
- Fixture Cost (amortized)
- Programming Cost (amortized)
- Additional Amortized Investments
- Total Amortized Investments
- Fully Burdened Cost
- Unit Cost
- Hard Tooling
- Fixture Cost
- Programming Cost
- Total Capital Investments

Formula Dependencies are provided only for the following Part-Level fields.


- Batch Cost
- Annual Cost

- Lifetime Cost
- Total Production Volume

### To use the Show Formula Dependencies feature

- 1 In any cell in a **Details** tab, right click and select **Show Formula Dependencies**.
- 2 If the Formula Dependencies window displays a collapsed tree, expand it to explore what formulas contribute to this one.
- 3 (Optional): Enter overrides in fields with a pencil icon (  ).
- 4 (Optional): Click any formula to be taken to the Cost Model Workbench (CMWB) definition of the formula.

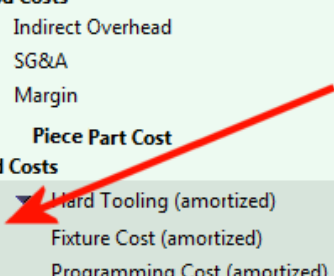
### Performing selective Cost Summary overrides

The **Enable Cost Overrides** command allows you to override individual Cost Summary values for a part or assembly. This command is available from the **Scenario** menu and from an icon (  ) on the tool bar.

When you select this command, a check box is displayed next to every cost value. Those that are editable have a checkbox with a 3D shadow; plain checkboxes indicate values that cannot be overridden.

<b>Period Costs</b>		
<input type="checkbox"/>	Indirect Overhead	10.32
<input type="checkbox"/>	SG&A	6.14
<input type="checkbox"/>	Margin	0.00
	<b>Piece Part Cost</b>	<b>139.26</b>
<b>Fixed Costs</b>		
<input type="checkbox"/>	Hard Tooling (amortized)	2.68
<input type="checkbox"/>	Fixture Cost (amortized)	0.00
<input type="checkbox"/>	Programming Cost (amortized)	0.00
<input type="checkbox"/>	Additional Amortized Investments	0.00
	<b>Total Amortized Investments</b>	<b>2.68</b>
	<b>Fully Burdened Cost</b>	<b>71.87</b>
<b>Capital Costs</b>		
<input type="checkbox"/>	Hard Tooling	0.00
<input type="checkbox"/>	Fixture Cost	134.24
<input type="checkbox"/>	Programming Cost	467.85
	<b>Total Capital Investments</b>	<b>602.10</b>

**Cannot be overridden**



In general, you cannot override amortized values, but you can override the Capital Costs fields, and these values will be amortized and will be reflected in the Fixed Costs fields.

Checking a specific check box opens the corresponding cost value for editing. You can override one or more values.

The cost value that has been checked for manual costing is no longer affected by changes to the component's GCDs, non-geometric cost drivers, or VPE data. However,


if you disable cost overrides, aPriori discards the manually specified values, re-evaluates the CAD geometry and computes the cost values for the component.

You can use cost overrides for cost values that can be calculated by aPriori as well as for those that aPriori does not consider at the moment.


For example, the material used to fabricate a part may require a special vendor-supplied finish or processing that is not reflected in the cost of the material stock specified in the VPE. In this case, you can override the material cost for this part to reflect the cost of material with the required finish. Alternatively, you may wish to override the material unit cost, which is used to compute the total material cost, using the Material Selection window. For more information on how to do this, see [Change material unit cost on page 141](#).

You can also use cost overrides to include the logistic cost to fabricate a component, such as internal or external shipping and handling, since by default aPriori does not compute logistics costs but does provide a Logistics field in the cost taxonomy.

### To enable and enter cost summary overrides

- 1 Click the  icon or select **Scenario > Enable Cost Overrides**. In the Cost Summary table, you see check boxes for the editable cost values.
- 2 Select a check box for each cost value that you want to edit. The cost value field becomes editable.
- 3 Enter a new value, then press **Enter** or move to another field. The cost totals associated with the value automatically re-calculate.
- 4 If desired, enter a note about the purpose or contents of the override in the Comment: window that appears just below the cost value field. After you have entered a comment for a cost override value, a small red triangle will appear in the upper right corner of the cell. You can click on that triangle to view or edit the comment in the future.
- 5 Click the **Save** button.

### To disable cost summary overrides

- 1 Click the  button or select **Scenario > Enable Cost Overrides**. aPriori discards the manually specified values, re-evaluates the CAD geometry and computes the cost values for the component.
- 2 Click the **Save** button.

## Performing total cost summary overrides

The **Scenario > Manually Costed** command allows you to specify all cost summary values for a part or assembly.

When you select this command (or when you select the **Manually Costed** process group in the **Cost Guide** and click **Cost Now**), a check box is displayed next to every editable cost value in the **Cost Summary** tab.. All check boxes are checked and disabled indicating that all costs are

specified manually and are not affected by changes to the components GCDs, non-geometric cost drivers, or VPE data.

If you disable manual costing, aPriori discards the manually specified values, re-evaluates the CAD geometry and computes the cost values for the component.

Manually costed components are typically used when the cost for the component is not determined by its geometry or production facility. For example, you may design a CAD model for a part that will be sourced from a supplier. In this case, the cost for the part will be determined by the supplier and manually entered into the aPriori Desktop.

While the GCDs and Manufacturing Process information do not impact the cost for a manually costed component, they can impact the process level costs when that component is used in an assembly.

### To create a manually costed component

- 1 Open a component (part or assembly).
- 2 Select **Scenario > Manually Costed**. Editable fields in the Cost Outputs pane change color.
- 3 For each field you want to edit, enter a new value and press **Enter** or move to another field. The cost totals associated with the value automatically re-calculate.
- 4 Click the **Save** button.

### To convert a manually costed part to aPriori costed

- 1 Open a manually costed part or assembly.
- 2 Select **Scenario > Manually Costed**. aPriori discards the manually specified values, re-evaluates the CAD geometry and computes the cost values for the component.
- 3 Click the **Save** button.

## Precedence of production input overrides

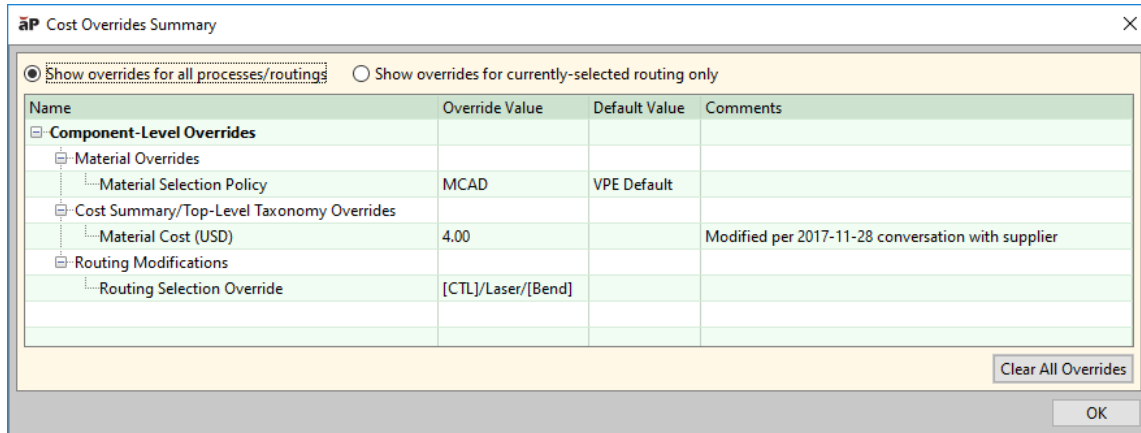
aPriori allows you to set and override production inputs in a variety of ways. Production inputs include settings such as Process Group, VPE, Material , Annual Volume, and Batch Size.

Here is the precedence aPriori follows for production inputs, in descending order:

- 4: User Override, if specified. For example, manually entering a value in the Cost Guide (see [Initial costing: the Cost Guide](#)), or providing a value on the input spreadsheet or via the UI for Bulk Costing (see [Bulk Costing and Analysis](#)). User overrides always "win".
- 3: CAD Property value, if provided. See [Costing with CAD Properties](#) for more information.
- 2: Preference value from **Tools > User Preferences > Default Production Inputs....**(see [Default Production Inputs](#)).
- 1: Site or VPE default, if specified. This will be used if none of the above apply.

# Working with the Overrides Summary dialog

As a companion to the ability to override computed values, aPriori provides a **Cost Overrides Summary** dialog.



This dialog summarizes the many different types of inputs and overrides you may have provided when costing a component, and also allows you to revert all or selected overrides.

Select **Edit > Cost Overrides Summary** from the Manufacturing Process pane to invoke the dialog. The dialog presents numerous types of overrides made to the part, including:

- Overridden fields in the Cost Summary, Part Details, and Assembly Details tabs. See [Overriding computed values](#) on page 112.
- Material selections (if a user explicitly selected a material rather than using the default material for the VPE). See [Selecting material](#) on page 138.
- Routing selections (if a user explicitly selected a routing rather than allowing aPriori to auto-select the routing based on lowest cost). See [Selecting a process routing](#) on page 182.
- Machine selections (if a user explicitly selected a machine rather than using the one chosen automatically by aPriori). See [Selecting a machine for an operation](#) on page 175.
- Feasibility rule overrides (if the user unchecked the box indicating the system should apply the default process and machine feasibility rules). See [Selecting a process routing](#) on page 182.
- Process Setup Option settings (if the user edited the default setting for any process setup options). See [Editing process setup options](#) on page 177.
- Tolerance and Roughness settings (if the user explicitly specified any tolerance or roughness values). See [Specifying or importing tolerance and roughness](#) on page 143.
- GCD Properties (such as indicating a hole is threaded). See [Editing values in the GCD properties table](#) on page 201.
- Production inputs if your installation has been configured to automatically map CAD properties. See [Costing with CAD Properties](#) on page 35..



In addition to organizing and summarizing these many types of inputs and overrides, the Cost Overrides Summary dialog also allows you to undo (revert) all or selected overrides. **The Clear All Overrides** button removes all inputs and overrides applied to the component, allowing you to start fresh. Alternatively, you can remove only selected overrides, such as all the overrides related to a given process, or a single field. Just select the desired row or set of overrides, right click, and select **Remove Override** from the popup menu.

**Note:** aPriori Professional Release 2018 R1 introduces three new override features:

1. Overrides that were not previously shown in the Overrides Summary dialog are now displayed:

Override	Process Group(s)
Flattening options	Sheet Metal-based process groups
Main Surface selection	Sheet Metal
User-defined Forms	Sheet Metal-based process groups
Build Direction	Additive Manufacturing
Draw Direction	Casting-Die, Casting-Sand, Forging, Powder Metal, Plastic Molding, Roto & Blow Molding, Sheet Plastic
Ram Direction	Sheet Metal - Transfer Die, Sheet Metal – Stretch Forming
GCDs excluded from slide/lifter bundling	Casting – Die, Plastic Molding
GCDs Unmerged from ComboVoids	Casting-Sand, Casting-Die, Plastic Molding, Roto & Blow Molding
Stock Form and Alignment	Stock Machining, Bar & Tube Fabrication
User-defined Setup Axes	Stock Machining, secondary machining
Limit Turning Axes	Stock Machining, secondary machining
User Defined Attributes*	All process groups
Tolerance Policy settings	All process groups

\*Previously an override to a User Defined Attribute field was shown only if the field supplied a default value. Now all overrides to User Defined Attribute fields are shown.

2. The Overrides Summary dialog now includes a **Comments** column, which displays any comments that may be associated with formula overrides.
3. Finally, information about the overrides made to an aPriori scenario can now be included in a spreadsheet report. See [Including information about scenario overrides](#) in Chapter 11 for more information.

## BOM reports

aPriori provides two reports to compare the differences between two large assemblies and roll-ups:

- BOM Comparison Report Piece Part Cost
- BOM Comparison Report Fully Burdened Cost

### To generate a BOM report

- 1 Open an assembly or roll-up in aPriori.

- 2 Select **Reports > BOM** from the aPriori menu bar and select one of the following options:
  - **BOM Comparison Report Piece Part Cost** – Select this option to list piece part costs and weights down to the component level, calculates the difference between these values for two assemblies or roll-ups line by line, and highlights the differences
  - **BOM Comparison Report Fully Burdened Cost**– Select this option to list fully burdened costs and weights down to the component level, calculates the difference between these values for two assemblies or roll-ups line by line, and highlights the differences
- 3 Select the assembly or roll-up for comparison against the active assembly or roll-up.

## Spreadsheet Reports

Documentation about aPriori Spreadsheet reports is now covered in its own chapter: *Spreadsheet Reports*

## Bulk editing components

In aPriori Desktop, you can simultaneously edit multiple objects:

- components within a single container — an assembly, a roll-up, or a comparison
- GCDs for a specific component

To change the Primary Process Group for multiple components included in an assembly, a comparison, or a roll-up, aPriori must be able to retrieve the GCDs required to calculate the cost. To make it possible:

- In Direct Integration mode, all components must be loaded into the MCAD system.
- In CAD-Independent mode, all components must be file-connected.

You can simultaneously edit only those values that the multiple objects have in common.

For example, to bulk edit the material for a set of components, the selected components must be set to the same facility, because materials are associated with a particular facility.

Similarly, to bulk edit the machines for a set of components, the selected components must be set to the same routing, because machines are associated with a particular routing.

To select multiple objects:

- **Ctrl-Select** — Hold down the Ctrl key and click on each object.
- **Shift-Select** — Select an object, hold down the Shift key, and select a second object. All the objects between the two selected objects (including the selected objects) are selected.
- **Left-mouse-Select** — Hold down the left mouse button, select an object, and drag the cursor to select multiple objects above or below.



## 6 Access Control

This section describes aPriori's Access Control mechanism.

---

This chapter includes the following topics:

- Access Control Overview
  - How it is implemented
  - How this might affect you
  - Access Control Principles
  - Additional details
-

# Access Control Overview

aPriori provides administrators with the ability to define which users have specific permissions to access particular elements within aPriori. As an end user, you do not need to be too concerned about this capability other than to be aware of whether or not it has been implemented at your installation. This chapter describes at a very high level how Access Control works, and how it might affect your day-to-day use of aPriori.

Detailed information about configuring Access Control is available in the aPriori *System Administration Guide*.

If you are not sure whether Access Control has been implemented at your site, you may want to ask your system administrator. If it has not been implemented, then nothing in this chapter applies to you. If it has been implemented, then this chapter will help you to understand certain behaviors or error messages that you might encounter.

## How it is implemented

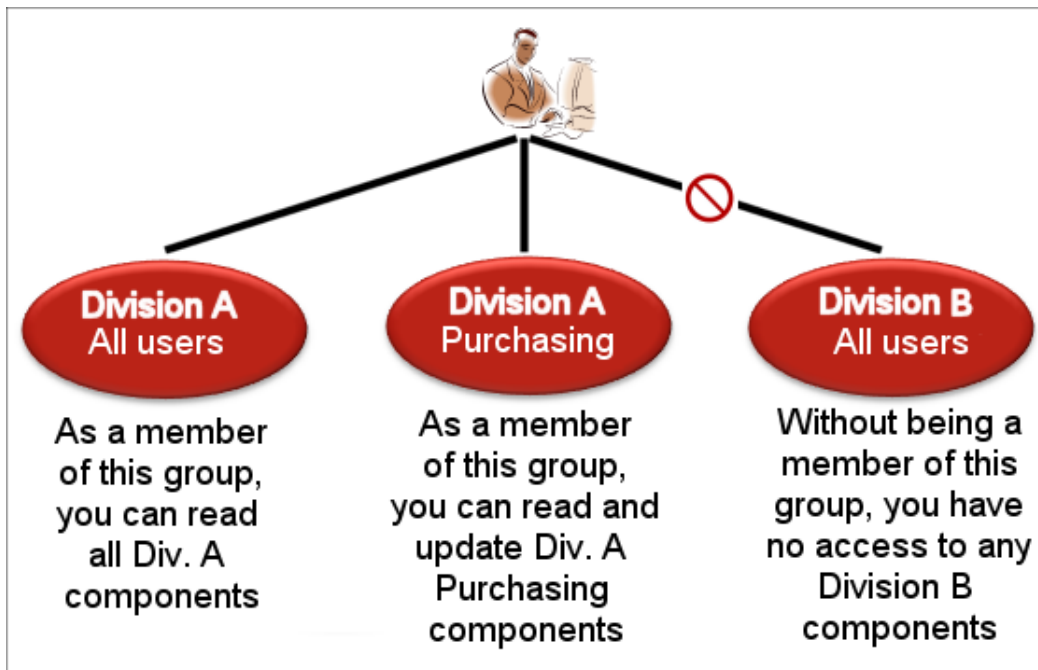
aPriori Access Control consists of three basic parts:

- Groups
- Permissions
- Resources

Groups are collections of users. Every aPriori user belongs to one or more groups. Permissions such as Read, Create, Delete, Update, etc. are associated with Groups. Resources such as components, roll-ups, VPEs, etc. are the targets to which permissions grant or deny actions.

Administrators use these building blocks to reflect your organization's structure, so that individuals have access to the things they need to get their work done, but which protect things from users who should not have access to them.

For example, you might belong to groups that allow you to read and update components from your own department, and which allow you to read -- but not update -- components from related departments. And you may not have any access at all to components from a different division of your company.



This is a very over-simplified example, and your administrator may have implemented a completely different model, but it gives you an idea of how Access Control might affect your day-to-day work.

## How this might affect you

Knowing that Access Control has been implemented at your site -- and understanding a few basics -- can help you to understand why certain things work the way they do.

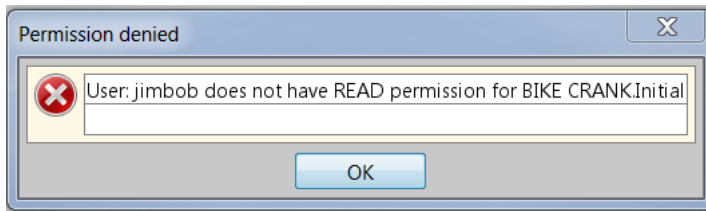
For example, if you search for a component that you know exists, but cannot find it, then it might be due to the fact that you do not have permission to view ("Read") it. Or if you open a component, make some costing overrides in the Part Details panel, and then are unable to save it, this might be due to you not having permission to Update that component.

These are relatively obvious situations, but some types of access issues can be more subtle, such as when working with Assemblies or Roll-ups where you have Read and Update permission to most, but not all, child components.

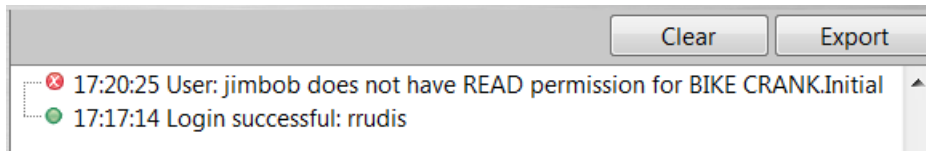
**Note:** If you are not comfortable trying to read and interpret log files, just ask your aPriori administrator to use the following procedures to understand the situation you are encountering.

### Error messages and log files

Where possible, aPriori displays an informative error message and adds it to the message tree whenever it denies access to something. Here is an example of an error message you might see:



And here is the related message as it might appear in the message tree:



aPriori also appends detailed information about access denials to the log file:

```
[java] 2014-11-12 17:26:43,617 INFO UserActions:256 - Opening scenario:Assembly-BIKE CRANK.Initial
[java] 2014-11-12 17:26:43,687 INFO GlobalDataSelector:248 - User: jimbo does not have READ permission for BIKE CRANK.Initial
[java] 2014-11-12 17:26:43,688 ERROR BeanUtil:296 - Invoke failed method:doOpenDisplayableItem InvocationTargetException caused by:com.fbc.util.core.security.AccessControlException Msg:User: jimbo does not have READ permission for BIKE CRANK.Initial invoked on:OpenScenarioTask:Assembly-BIKE CRANK.Initial
[java] 2014-11-12 17:26:43,689 ERROR BeanUtil:296 - com.fbc.util.core.security.AccessControlException: User: jimbo does not have READ permission for BIKE CRANK.Initial
[java] at com.fbc.datamodel.GlobalDataSelector.ensureCurrentUserHasPermission(GlobalDataSelector.java:2738)
[java] at com.fbc.datamodel.scenario.ScenarioManagerImpl.getScenario(ScenarioManagerImpl.java:610)
```

These are the first sources of information that you should check when trying to understand why aPriori is not allowing you to do something.

**Note:** For security reasons, aPriori cannot always provide detailed enough information about access denial situations to identify exactly what target resource has failed which access check. For example, if there is a proprietary or otherwise sensitive component in an assembly that a group of users is not allowed to even see, then it would defeat the purpose of Access Control to deliver a detailed message that says something like "You do not have permission to read SecretComponentXYZ."

Also note that in certain circumstances, aPriori aborts after reporting the first error. For example, if you try to deep-cost an assembly which contains child components to which you do not have Read access, aPriori displays a message about the first such component and stops trying. You will not get error messages about other non-readable components in the Assembly. See *Access Control Principles* on page 131 for more information.

## Using Search

For the aPriori Search mechanism, Access Control checks are performed when you try to open an entity that appears in the search results, not when the search is performed.

When you use **Search**, ALL scenarios that meet the search criteria are displayed, just the same as if Access Control has not been implemented at your site. Even if an entity does not have Read permission, it will still be listed in the Component Scenarios area.

However, only a small sub-set of its fields are displayed: no cost data is shown, and no thumbnail is displayed. This approach strikes a balance between performance and security: to perform comprehensive Access Control checks during the search, aPriori would need to load everything and check it on-the-fly, which could cause unacceptable slow-downs.

When you place the cursor over such an entity, a tooltip message appears informing you that you do not have access to the component.

Thumb	Name/Part #	Scenario Name	Piece Part Cost (USD)	Total Capital Investments (USD)	Annual Volume	VPE	Process Group	Material Composition
	AP_FORGING_EXERCISE_EL0000	initial			5,500	aPriori Mexico	Forging	
	AP_FORGING_EXERCISE_EL0000	what if	11.10	4,253.23	5,500	aPriori China	Forging	Steel, CR, Al

Once you try to *open* such an entity, aPriori displays an access error message as described in the previous section.

**Note:** This behavior is observed wherever **Search** is used in aPriori: for example, switching components in Assemblies, deleting components and adding components to Rollups, etc.

## VPEs

VPEs have some special Access Control requirements. If you do not have Read access to a VPE, it is like it does not exist. If you have just Read access to a VPE, you can view it, but you cannot cost a part against it. To be able to cost parts against a VPE you must have both Read and Cost Using permissions (Cost Using is a special permission implemented specifically for VPEs).

## Costing

To cost a component against a specific VPE, you must have Read + Cost Using permissions for that VPE.

This means that if your component uses multiple VPEs for different routings, you must have these permissions for every VPE.

Note that if you do not have Read + Cost Using permissions for a VPE, it will not appear as an option in the **Virtual Production Environment Selection** dialog.

## Deep Costing and Costing All Scenarios

Deep Costing and Cost All Scenarios are the same as basic component costing except that you must have Read + Cost Using permissions for all VPEs covering all scenarios and child components. These operations follow the "Keep going & notify" principle (see the next section, "Access Control Principles").

## Material Catalog

Cost Using is not necessary to specify a VPE for the Material Catalog; only Read permission is required.

## Overlay VPEs

Overlay VPEs are created from one or more VPEs to which they maintain a link, so that that updates to the parents ("antecedents") get passed on to the child. This is a somewhat advanced topic which is covered in the *aPriori VPE Administrator Guide*.

If your site makes use of overlay VPEs:

- For costing, you must have Read + Cost Using permissions on the overlay VPE, but no access is required to the antecedent VPE(s).
- For editing, you must have Read + Update permissions on the overlay VPE, but no access is required to the antecedent VPE(s).

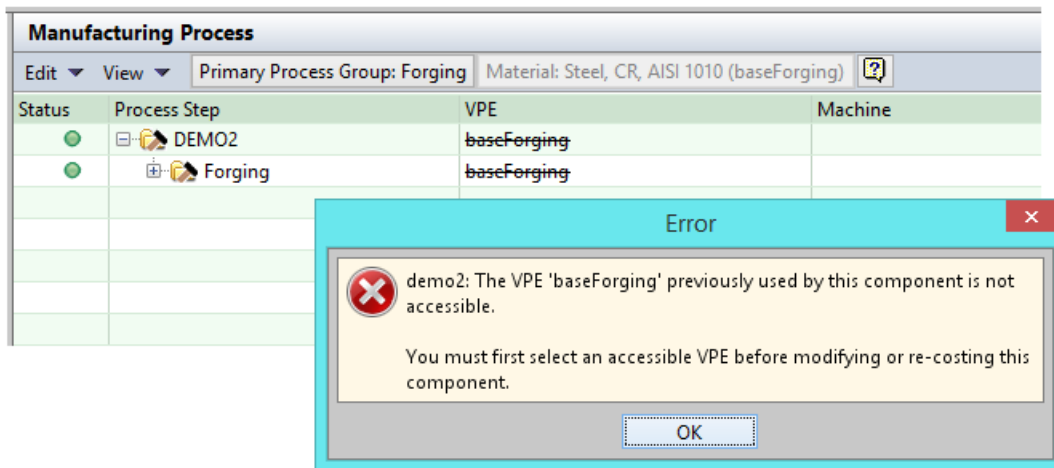
## VPE Manager

To use the VPE Manager window, you must have Read permission to a VPE to open and view it.

To edit and delete a VPE, you must have Update and Delete permissions to it. You must also be a VPE Administrator (the same as when Access Control is not in effect).

## Viewing a Costed Component

To view an existing, costed component, you do not need VPE access. However, any VPE to which you do not have access that appears in the Manufacturing Process pane is displayed with a "strikethrough" name (similar to a deleted VPE).





## Access Control Principles

This section gets into some advanced concepts regarding how Access Control is implemented. If you are an end-user, feel free to skip over this material. You do not need to know it to get your job done. But if you are curious about how Access Control works, this section can help explain how things behave in an Access Control environment.

aPriori has implemented Access Control so that it performs its job securely in as unobtrusive a manner as possible, adhering to the following principles. The first four are always true:

- 1 You cannot grant yourself new permissions as a result of updating an entity. For example, you cannot change the value of an attribute to give yourself Update rights if you did not have those rights already.
- 3 You cannot give away permissions you had as a result of updating an entity. For example, if you had Read + Update rights, you cannot change the value of an attribute so that you cannot Read or Update it anymore.
- 4 Fail fast when possible: For example, in order to BOM load, you need to be able either to Create and Read and/or Update the parent rollup and potentially any functional group rollups. aPriori checks these conditions up front and fails immediately if it finds a problem, before starting the BOM load operation.
- 5 Check before destroy: aPriori checks Access Control permissions before deleting data. For example, using **File > Import** to import scenarios from an ".ap" file will delete any existing scenarios that conflict with the ones being imported. Before performing the delete, aPriori verifies that the importing user has the necessary permissions for the entire import to succeed.

One of the next two rules will apply depending on the situation:

- 1 Keep going and notify: Once past the initial "fail fast" checks, for operations that involve manipulation of multiple scenarios, aPriori skips over scenarios that fail due to Access Control but logs the issue and notifies the user. For example, after the initial check for rollups, the BOM loader loads everything it can and notes any access control failures.
- 2 Abort the entire operation: If any part of an Update operation fails due to Access Control, the entire operation is aborted and aPriori attempts to clean up (delete) any scenarios created up to that point. For example, **Scenario > Save As > Scenario & Children** could fail an Access Control check after already processing some number of scenarios. In this case, aPriori stops the save and cleans up any scenarios that were created. (Spreadsheet reports work in the same manner, except that there is no need to clean up.)

**Note:** "Fail fast when possible" does not apply in this situation for performance reasons. It would not be efficient to visit each scenario to check if all permissions are okay before performing the Save operations.

## Some additional guidelines to remember

In addition to the principles listed in the previous section, there are some basic Access Control rules that might help you to understand how things work:

- 1 You might belong to multiple groups. Every aPriori user belongs to at least one group: All Users. But your administrator has probably also made you a member of one or more other groups that reflect something like your region, or the project(s) you work on, or the type of work you do.
- 2 In general, to have particular access permission to a particular entity, you must belong to at least one group that grants that permission, and not belong to any group that denies that permission. (However, administrators can tweak this rule so that grants and denials are strengthened or weakened.)
- 3 The most restrictive permission is the one that counts. For example, you might belong to one group that allows you to update a component, and to another group that explicitly prohibits you from updating that component. In this case, the "deny" permission takes precedence and you will not be able to update the component.

## Additional details

Again, as a day-to-day user, you probably do not need to get any deeper into the details of Access Control -- that is an area for your system administrator. However, if you are trying to figure out a behavior that you are seeing, the additional details below may help you understand how Access Control is working.

## Resources

Here are all the target resources that aPriori Access Control can create rules for:

- Components (includes Parts and Assemblies)
- Roll-ups (includes basic Roll-ups, Dynamic Roll-ups, and Cost Comparisons)
- VPEs
- There are also advanced resources for Groups and Permissions, so that administrators can implement "Access Control for Access Control". But this is an advanced administration feature that should not concern you.

## Permissions

Permissions are actually expressions made up of resources, actions, and rules, but for the purposes of this discussion, we will only consider the action -- the aPriori operations that can be permitted or denied by Access Control:

- Create
- Read
- Update
- Delete
- Cost Using

These are mostly self-explanatory except for Cost Using. This permission action applies only to VPEs and determines whether you can cost a component against a particular VPE. There is also another advanced permission called "Associate" which administrators use with Permissions and Groups.

# 7 Manufacturing Process Information

The Manufacturing Process pane contains manufacturing input information for components. This section provides information on the manufacturing process routing tree/table and the manufacturing process commands.

---

This chapter includes the following topics:

- Manufacturing process routing tree/table
  - Manufacturing process commands
  - Selecting a primary process group
  - Selecting material
  - Editing production, administrative, or quote information
  - Specifying or importing tolerance and roughness
  - Editing yields
  - Selecting a virtual production environment (VPE)
  - Selecting a machine for an operation
  - Editing process setup options
  - Selecting a process routing
  - Creating custom processes and routings
  - Highlighting associated GCDs
  - Specifying simultaneous operations
-

# Manufacturing process routing tree/table

The Manufacturing Process tree/table shows the sequence of steps required to manufacture a component.






Manufacturing Process			
Edit ▾ Primary Process Group: Bar & Tube Fab ⓘ Material: Steel, HR, AISI 1010 (vol=Med) ⓘ			
Status	Process Step	VPE	Machine
	5250316	aPriori USA (medium)	
	Bar & Tube Fab	aPriori USA (medium)	
	Material Stock	aPriori USA (medium)	Default Material Stock
	AsSuppliedSurface		
	Sawing	aPriori USA (medium)	
	Circular Saw	aPriori USA (medium)	Behringer VM5-300-PV
	Punching	aPriori USA (medium)	Criterion P-D-1 76
	ComplexHolePunching		
	SimpleHolePunching		
	Bending	aPriori USA (medium)	
	Compression Bending	aPriori USA (medium)	Pines Model 3T
	Trimming	aPriori USA (medium)	
	Circular Saw:2	aPriori USA (medium)	Behringer VM5-300-PV

Each manufacturing step may include further operations. Operations are organized by manufacturing technique. You can drill down into the GCDs for each specific operation.

Each manufacturing step presents iconic status and user input indicators. The status indicator provides a red/yellow/green icon to indicate an error/warning/success status. The user input indicator provides a green user icon to indicate that you have made an explicit component or process level edit (e.g. machine selection or Process Setup maintenance).

The following icons are used in the routing tree/table:

Icon	Usage
	An operation.
	An operation selected by aPriori.
	An operation selected by you.
	Multiple operations.
	Multiple operations selected by aPriori.
	Multiple operations selected by you.
	A sub-operation selected by aPriori.
	A sub-operation selected by you.
	A GCD.

Icon	Usage
	A GCD selected by aPriori.
	A GCD selected by you.
	Multiple GCDs
	Multiple GCDs selected by aPriori
	Multiple GCDs selected by you.



A status indicator in the **Status** column shows the costing status of the operation:

- Green — costing completed successfully.
- Yellow — costing succeeded with a warning. Typically, a warning means that the requested operation could not be used in costing, but costing succeeded with an alternative operation.
- Red — costing failed.

## Manufacturing process commands

The command buttons and the Edit and right-click menus in the Manufacturing Process pane provide commands for viewing and/or editing the details available for each step in the manufacturing process. Commands that are not allowed for a step are disabled.

The following commands are available in the Manufacturing Process pane:

For an aPriori component	
To change the primary process group	Click the <b>Primary Process Group</b> command button.
To display the Primary Process Group details	Click the  command button next to the <b>Primary Process Group</b> button.
To edit material details	Click the <b>Material</b> command button or select <b>Edit &gt; Material Selection</b> .
To display the details of the currently selected material	Click the  command button next to the <b>Material</b> button.
To edit production information	Select <b>Edit &gt; Production Info</b> .
To edit the tolerance policy for a component	Select <b>Edit &gt; Tolerance Policy</b> .
To select and edit a routing	<b>Edit &gt; Routing Selection</b> or right-click > <b>Routing Selection</b> .

For a process step in the routing tree	
To edit yields	<b>Edit &gt; Edit Yields</b> or right-click > <b>Yields</b> .

For a process step in the routing tree	
To select a VPE	<b>Edit &gt; VPE Selection</b> or right-click > <b>VPE Selection</b> .
To display VPE details	<b>Edit &gt; Show VPE details</b> or right-click > <b>Show VPE details</b> .
To manually select a machine for a process	<b>Edit &gt; Machine Selection</b> or right-click > <b>Machine Selection</b> .
To edit the process setup options	<b>Edit &gt; Process Setup Options</b> or right-click > <b>Process Setup Options</b> .
To select and edit a routing	<b>Edit &gt; Routing Selection</b> or right-click > <b>Routing Selection</b> .
To highlight associated GCDs	<b>Edit &gt; Highlight Associated GCDs</b> or right-click > <b>Highlight Associated GCDs</b>


## Selecting a primary process group

A process group is a group of processes of the same manufacturing type. For example, the Sheet Metal process group includes such processes as Laser Cut, Bend Brake, Shear, etc.; while a Casting process group includes Cool, Cleaning, Hot Box, Melting, etc.

Some components may be completely manufactured using processes in a single process group. Other components require multiple process groups; for example, Casting and Machining.

The name of the process group that is primarily used to manufacture a component shows on the **Primary Process Group** button.

### To display the primary process group details

In the Manufacturing Process pane, click the  button to the right of the Primary Process Group button. The Process Group Details window is displayed.

To select a different Primary Process Group, click **Edit**.

To close the Process Group Details, click **Close**.

### To change the primary process group

To change the Primary Process Group for a component, aPriori must be able to retrieve the GCDs required to calculate the cost. To make it possible:


- In Direct Integration mode, the component must be CAD-connected.
  - In CAD-Independent mode, the component must be file-connected.
- 1 In the Manufacturing Process pane, click the Primary Process Group button, **Primary Process Group: Casting**. The Select Primary Process Group window is displayed.
  - 2 Select a process group from the drop-down menu. The required GCDs are immediately retrieved and the component is re-costed.

- Click **Close**. The new Primary Process Group shows on the command button.

## Selecting material

Material is the name of a chemical composition or alloy of which a part is made. Material can be selected only for parts.

### To display the details of the currently selected material

Click  to the right of the Material button to display the **Material Details** window. Click **Edit** to edit Material Details or click Close to close the window.

### To edit material details

- In the Manufacturing Process pane, click the **Material** button Material: Aluminum AL380. The Material Selection window is displayed.

The **Part Number** and **VPE** selected for this part are displayed in the window header. The list of materials shows all the materials available for the selected VPE. Material automatically selected by aPriori is highlighted and the related properties are displayed in the **Properties** list. The **Description** panel shows material stock size and form.

- In this window you can:
  - Change material catalog



- Change selection policy
  - Select material
  - Change material stock
  - Change material unit cost
  - Change material utilization
- 3 After making changes, click:
- **Ok** — to apply changes, recalculate the cost, and close the Material Selection window.
  - **Apply** — to apply changes and recalculate the cost without leaving the Material Selection window.
  - **Cancel** — to close the Material Selection window without applying the changes.

Status indicators appear separately for **Material Composition** and **Material Stock**. An overall results status indicator appears in the **Results** area.

A status indicator shows the costing status of the input:

- Green — Costing completed with the requested input.
- Yellow — Costing completed with warnings. Typically, indicates that the requested input was invalid and a different input, based on selection policy, was used for costing.
- Red — Costing failed.

You can see the warnings in the Status Messages pane.

**Note** If the costing results are outdated, the status indicator is not displayed.

## Change material catalog

By default, the current material catalog is the catalog associated with the current VPE. You can change the current material catalog to the catalog associated with a specified VPE.

### To change the material catalog

- 1 In the Manufacturing Process pane, click the **Material** button.
- 2 In the Material Selection dialog, click the button next to the label **Material Catalog**. By default, the button is labeled with the name of the current VPE.
- 3 In the Material Catalog Selection dialog, select the VPE associated with the desired catalog. Click OK. The Material Catalog button is now labeled with the name of the new current catalog's associated VPE.

## Change selection policy

The selection policy describes:

- how the material selection input is provided — by you or through the CAD system

- what aPriori does if the provided input is invalid

### To change the selection policy

- 1 In the Manufacturing Process pane, click the **Material** button.
- 2 In the Material Composition panel, click **Edit Selection Policy**. The Composition Selection Mode panel opens.
- 3 Select:
  - **MCAD** — this is the default source for material selection. If the MCAD choice is not provided or not available for the selected VPE, the VPE default material is selected.
  - **VPE Default** — The default material must be defined for every VPE.  
For information on how to define the default material for a VPE, see aPriori Administrator Guide.
  - **Manual** — Material selected manually by you. The VPE default is selected if your specified choice cannot be costed.
- 4 Click **Ok** to apply changes, recalculate the cost, and close the Material Selection window, or **Apply** to apply changes and recalculate the cost without leaving the Material Selection window.

The Material Composition Mode that you select here shows in the **Requested** field. If the material selected using this mode is invalid for costing, aPriori chooses a different mode according to the selection policy. However, the requested mode remains the same until you change it manually.

For example, if you selected MCAD, but the material specified by the CAD system is unavailable for the selected VPE, the VPE default material will be used for costing. The **Requested** mode will be **MCAD** and the **Selected** mode will be **VPE default**.

## Select material

### To select material

- 1 In the Manufacturing Process pane, click the **Material** button.
- 2 Select a material from the list. This changes the selection policy to **Manual**.  
The **Selected** field shows the selection policy and the selected material.
- 3 Click **Ok** to apply changes, recalculate the cost, and close the Material Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the Material Selection window.

## Change material stock

The Material Stock panel shows the following information:

- **Requested** — the requested stock source, **Auto** or **Manual**. A third option, **Custom Cut**, is available for Bar & Tube Fabrication parts.

- **Selected** — the presently selected stock.

### To change material stock

- 1 In the Manufacturing Process pane, click the **Material** button. The Material Selection window is displayed.
- 2 Click the button in the Material Stock panel. The Material Stock panel expands.
- 3 Select a material stock mode.
  - **Auto** — aPriori selects the material stock. This is the default option.  
The algorithm for automatic stock selection is defined as part of the facility model. Typically, the stock selection algorithm depends on geometry constraints, material utilization, machine selection, and routing selection.  
If no valid stock is available, aPriori computes the cost with virtual stock.
  - **Manual** — You select the material stock from the list of material stock available for the selected material composition.
  - **Custom Cut** — Available for Bar & Tube Fabrication parts only, you specify a custom stock length, either by specifying the total length or indicating size-to-fit with a specified trim allowance.
- 4 Choose **Manual** and select an available material stock from the list. Stock that is not valid is disabled.  
  
or  
  
For Bar & Tube Fabrication parts, Specify Custom Stock inputs (total length or trim allowance).
- 5 Click **Ok** to apply changes, recalculate the cost, and close the Material Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the Material Selection window.  
  
**Note** If no appropriate stocks are found in the list of available material stocks, then the Manual option is grayed out, and the system will create a virtual stock. This can happen, for example, if all stock cross-sections are too small to accommodate the part.

### Change material unit cost

The Material Unit Cost panel shows the unit cost (cost per mass) of the selected material composition/stock. By default, aPriori uses the unit cost value that is specified in the VPE for that material composition/stock. However, if this value does not reflect the value that will actually be in effect for this part (for example, if material prices have changed significantly since the VPE last was updated), you can override the value used for the current part.

#### To override material unit costs for the current part

Click the Override radio button in the Material Unit Cost panel, and enter the new material unit cost (take care to note the units)


## To revert to using the value specified in the VPE

Click the VPE Material Unit Cost radio button

## Change material utilization

The Material Utilization panel shows the selected utilization mode. Material utilization can be computed or can be entered different ways to drive starting material mass and cost.

### To change material utilization

- 1 In the **Manufacturing Process** pane, click the **Material** button. The Material Selection window is displayed.
- 2 Click the  button in the Material Utilization panel. The Material Utilization panel expands.
- 3 Select the material utilization mode:
  - **Computed** — aPriori computes utilization with a facility defined algorithm. The algorithm used varies by process group; more detail is given in the chapters for each process group in the *aPriori Cost Model Guide*.
  - **Machine Default** — aPriori uses the selected machine's default utilization value.
  - **Override** — You specify the material utilization value in the % field. If you selected **Override**, enter the value in the % field.
- 4 Click **Ok** to apply changes, recalculate the cost, and close the Material Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the Material Selection window.

## Editing production, administrative, or quote information

Production information includes parameters related to component production that affect the cost or the component.

### To edit production, administrative, or quote information

In the **Manufacturing Process** pane, select **Edit** >:

- **Production Info** to display the **Production Info** tab of the **Cost Object** window.
- **Administrative Info** to display the **Administrative Info** tab of the **Cost Object** window
- **Quote Info** to display the **Quote Info** tab of the **Cost Object** window

For more information about the fields on these tabs and their impact on costing and analysis, see *Using the Cost Object Info window* on page 41 and *Initial costing: the Cost Guide* on page 21.

## Specifying or importing tolerance and roughness values

You can specify geometric and dimensional tolerances (G&DT) and surface roughness requirements for GCDs. You can also automatically import many of these values directly from CAD model Product Manufacturing Information (PMI) attributes. Tolerance and surface roughness requirements can have a large impact on the process or operation selected to manufacture a GCD and the cycle time required to complete it.

aPriori stores tolerance capability data for each manufacturing process in the lookup table `tblGtolProcessCapabilities` (see [\\* CAD Angularity GD&T callout](#) maps to Bend GCD in Bar & Tube only. Entered manually only.

How aPriori calculates achievable tolerance ranges). When aPriori costs a GCD, it selects only those processes and operations which can meet the specified tolerances and roughness requirements for that GCD. If the primary process group cannot meet the tolerance or roughness requirements, aPriori selects secondary machining operations. If no secondary machining operations are available or capable of achieving the specified tolerance and roughness, the GCD fails to cost.

If no tolerance or roughness values are specified (by either importing or manually entering the desired value), aPriori assumes all processes can achieve the desired tolerance and roughness; aPriori does not set default desired tolerances.

Tolerance and roughness specifications also affect the cycle time required to complete an operation. For example, lower finish machining feed rates are required to achieve tighter (smaller) tolerance values, which results in increased cycle times. aPriori machining cost models account for this best practice. See [How aPriori determines cycle time adjustment factors](#).

You can specify tolerance and roughness requirements in one of three ways:

- By manually setting default values for all of a component's GCDs through the **Tolerance Policy Editor**.
- By manually setting values for specific GCDs either through the **Tolerance Editor**, or by using the fields in the **Geometric Cost Drivers** panel.
- By importing semantic PMI annotations directly from the CAD model.

**Note:** aPriori stores and displays tolerance values as *total* tolerance. This means, for example, that if a CAD system specifies a tolerance of "±0.25", you should enter the total tolerance, "0.5". If you import such a tolerance from a PMI attribute, the aPriori will display it as a total tolerance.

## How tolerances map to GCDs

Each tolerance and roughness type applies only to certain GCD types. The following table which shows what types of tolerance apply to each GCD type, and whether they can be imported as PMI from CATIA, Creo, NX, and SolidWorks:

	Symbol	Curved Surface	Curved Wall	Keyway	Planar Face	Simple Hole	Complex Hole	MultiStep Holes	Edge /Edge-Segment	Bend (B&T)	Lance	Import from PMI?
Tolerance (coordinate)		X	X	X	X	X	X		X		X	N
Roughness Ra		X			X	X						Y, except Solidworks
Roughness Rz		X			X	X						Y, except Solidworks
Diam Tolerance		X	X			X						Y
True Position			X		X	X			X		X	Y
Bend Angle Tolerance										X*		N*
Circularity			X			X						Y
Concentricity			X			X						Y
Cylindricity			X			X						N
Flatness					X							Y
Parallelism			X		X	X				X		Y
Perpendicularity			X		X	X						Y
Profile of Surface		X	X		X							Y
Runout		X	X			X						Y
Total Runout			X			X						Y
Straightness			X	X	X	X						Y
Symmetry		X	X	X	X	X						Y

\* CAD Angularity GD&T callout maps to Bend GCD in Bar & Tube only. Entered manually only.

## How aPriori calculates achievable tolerance ranges

Given a process and a GCD's size, aPriori can determine the range of tolerances that the process can achieve for that GCD. The achievable tolerance range helps determine operation feasibility (the tolerance required for the GCD must be no tighter than the best achievable tolerance for the operation's parent process). The achievable tolerance range also helps aPriori adjust cycle times based on required tolerance (see [How aPriori determines cycle time adjustment factors](#)).

aPriori determines the best and worst tolerance that a given process can achieve for a given GCD as follows:

- 1 Determine the best and worst achievable tolerance grade for the process: the lookup table **tblGtolProcessCapabilities** associates two International Tolerance (IT) Grades with each process, the best achievable tolerance grade and the worst achievable tolerance grade. (Some entries in the table refer to a group of processes, rather than an individual process; in this case, every process in the group has the same best and worst achievable tolerance grades.) aPriori looks up the best and worst achievable grades by process (or group) in **tblGtolProcessCapabilities**. Note that IT Grades are independent of feature size but can be used together with size to obtain a literal tolerance range.
- 2 Determine a size value for the GCD as follows:

GCD	GTOL Category	GCD Size
Simple Hole	Position Tolerance	Part length/2
Simple Hole	All other GTOL categories	Diameter
Curved Wall	Diameter Tolerance	Diameter or bend diameter (if diameter is null. If both are null, use Sqrt(Finished area)
Curved Wall	Position Tolerance	Part length / 2
Keyway	Symmetry	Max of GCD length, width, and height
Remaining GCDs	Remaining Categories	Sqrt(Finished area)

- 3 Use the size value (obtained in step2) and the best or worst achievable tolerance grade (obtained in step 1) in the formula below, in order to calculate best or worst achievable tolerance. This is the literal tolerance value that takes GCD size into account:

$$\text{Tolerance} = 10^{(0.2 * (\text{Grade} - 1))} * (0.45 * \text{Size}^{(1/3)} + 0.001 * \text{Size}) / 1000$$

Note that, unlike achievable tolerances, the achievable roughness for a process and GCD does not depend on the GCD's size. Literal achievable roughness ranges are stored directly in **tblGtolProcessCapabilities**, and they require no conversion based on GCD size.

**Note:** As of Release 16.2, aPriori has added roughness “Rz” to the existing roughness specification found in earlier releases. Throughout the UI, all Rz and Ra specifications are clearly labeled. If you encounter a roughness specification with

no Rz or Ra label, it is Ra. By default, if no Roughness Rz value is specified, the default “Best Achievable”/“Worst Achievable” values for Roughness Rz are 4.5 times the value of the specified Roughness Ra.

Besides GCD size and process, another factor that can affect best achievable tolerance is the GCD’s distance from some relevant datum feature, but aPriori does not currently take this into account.

**Note:** The Injection Molding process allows for significantly tighter “Best Achievable” surface roughness than machining processes (such as those that might be used to make the mold). This is because the best tolerances in Injection Molding are achieved via hand polishing of the mold surface, which is not available in other processes. This results in Injection Molding being more capable than other processes with regard to tolerance/surface finish.

## How aPriori determines cycle time adjustment factors

Cycle times for a given GCD and process are adjusted with a compensation factor that is based on the following:

- Tolerance that you specify (or import) for the GCD
- Tolerance range for the process and the GCD (see \* CAD Angularity GD&T callout maps to Bend GCD in Bar & Tube only. Entered manually only.
- How aPriori calculates achievable tolerance ranges)
- Compensation factor range specified by `plant.gtolWorstAchievableFactor` (0.75 in the Starting Point VPEs) and `plant.gtolBestAchievableFactor` (1.5 in the Starting Point VPEs).

The position of the specified tolerance within the tolerance range determines the position of the compensation factor within the compensation factor range. If the tolerance specified for a GCD is at the midpoint of the tolerance range, then the compensation factor is 1. If the tolerance specified is in the bottom half of the tolerance range, the compensation factor is between `plant.gtolWorstAchievableFactor` and 1. If the tolerance specified is in the top half of the tolerance range, the compensation factor is between 1 and `plant.gtolBestAchievableFactor`.

In particular, if the tolerance specified is a certain fraction of the way from the worst achievable tolerance to the midpoint of the tolerance range, the compensation factor is that same fraction of the way from `plant.gtolWorstAchievableFactor` to 1.

Similarly, if the tolerance specified is a certain fraction of the way from the midpoint of the tolerance range to the best achievable tolerance, the compensation factor is that same fraction of the way from 1 to `plant.gtolBestAchievableFactor`.

If a tolerance for a GCD has not been specified, the compensation factor is 1.

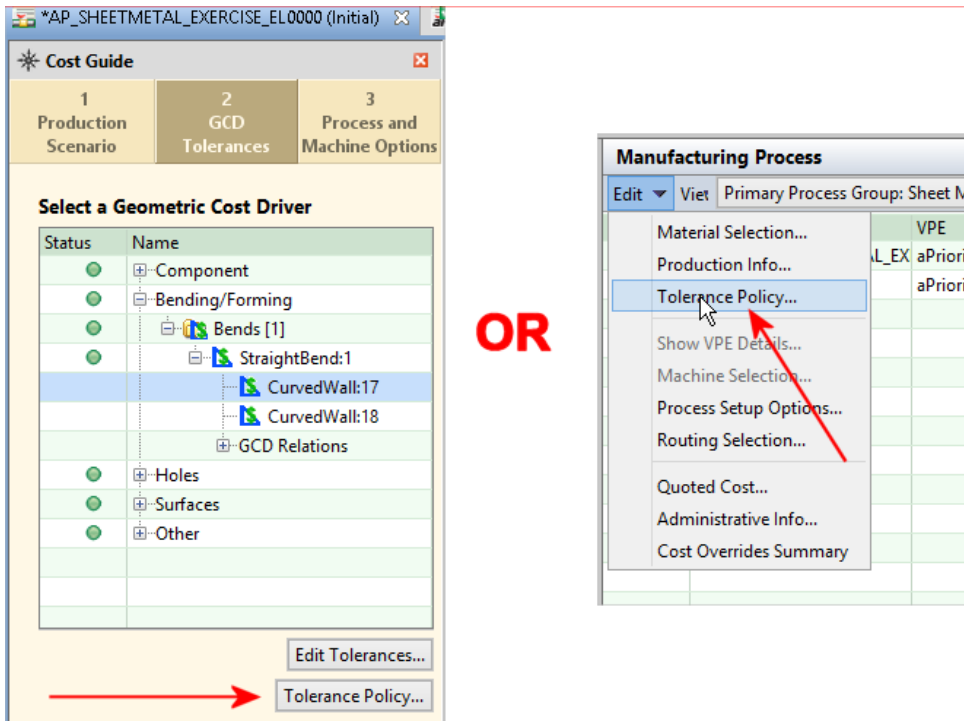


## Using the Tolerance Policy Editor

You use the **Tolerance Policy Editor** to enter tolerance and roughness values for all GCDs in a component. You also use it to control the import of PMI attributes from the CAD model (see the next section).

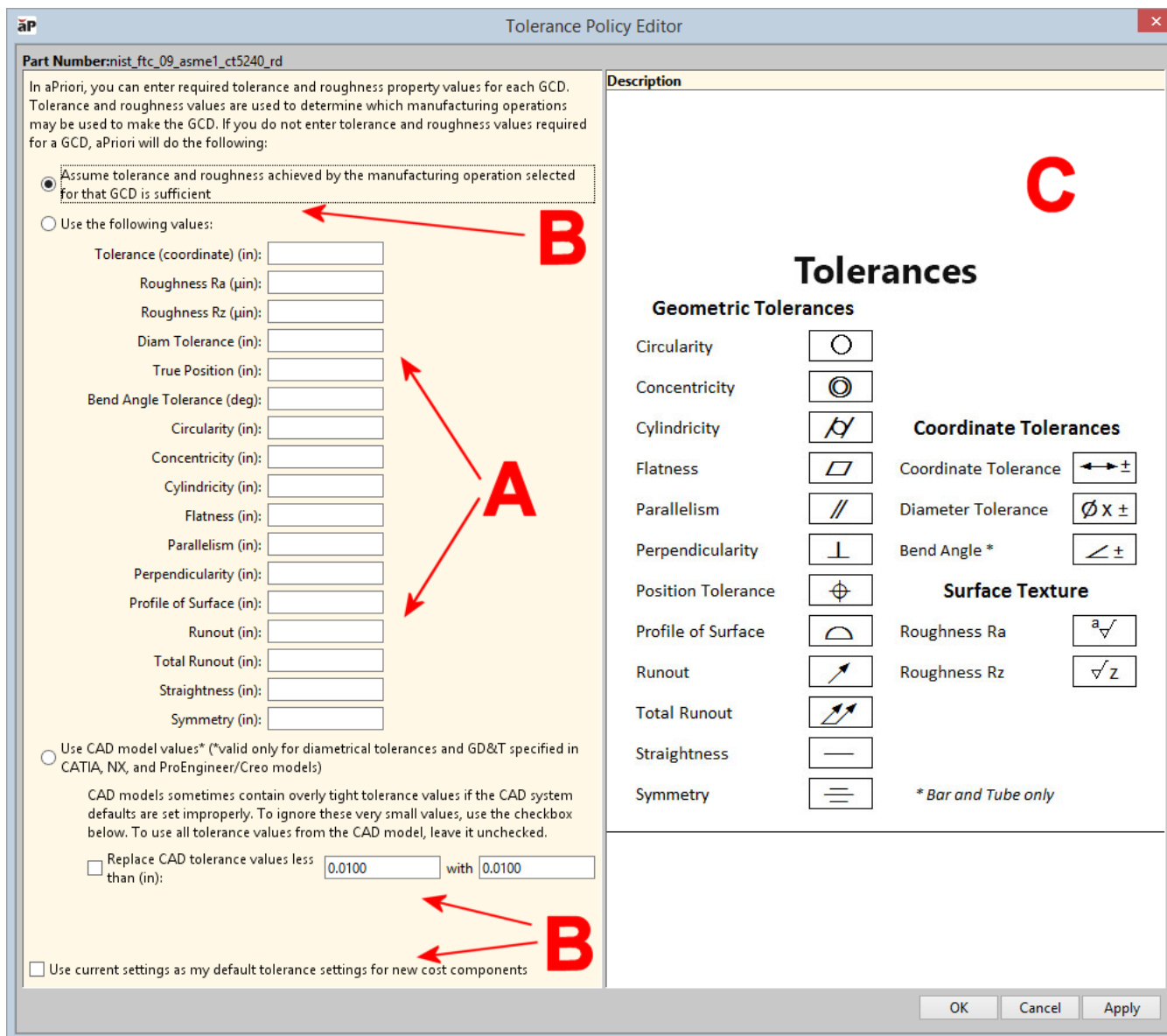
### To open the Tolerance Policy Editor

- There are two ways to open the **Tolerance Policy Editor**:
  - From the middle tab of the **Cost Guide**, or
  - From the **Edit** menu in the **Manufacturing Process** panel.



2 The Tolerance Policy Editor provides the following features:

- **A:** A set of fields for manually entering tolerance and roughness values that should be applied by default to GCDs in the component.
- **B:** Radio buttons and checkboxes for controlling tolerance and roughness behavior, including whether or not to import PMI values directly from the CAD file.
- **C:** A reference panel showing common drafting symbols for supported tolerance and roughness specifications.



The tolerance mode controls include:

- **Assume tolerance and roughness achieved by the manufacturing operation selected for that GCD is sufficient** — This is the default tolerance policy. If you do not manually enter tolerance or roughness requirements for any GCDs, and do not import PMI attributes from the CAD model, the GCD tolerance and roughness requirements are set to

unspecified and aPriori evaluates routings assuming that the processes have sufficient tolerance capabilities to manufacture the GCD. That is, aPriori does not determine that a process or operation is infeasible or check secondary machining operations based on achievable tolerance and roughness requirements. If you do specify or import tolerance or roughness requirements for a GCD, tolerance and roughness capabilities *are* evaluated during routing and operation sequence selection.

For more information on explicitly setting tolerance and roughness values for a GCD, see [Editing values in the GCD properties table](#) and [GCD commands](#).

- **Use the following values** — Select this option to enter the default tolerance and surface roughness for the part. These values are used for each GCD that does not have values manually set at the GCD level.
- **Use CAD model values** — Select this option if you want aPriori to use the tolerance and roughness specified by semantic PMI attributes in the CAD model (currently supported for Creo, CATIA, and NX).
- **Replace CAD tolerance values less than:** -- If the CAD model has overly tight tolerance values (which sometimes occurs if tolerance defaults are set by CAD PMI imports), check the box, enter a limit for the overly tight tolerance values, and enter a replacement value.

**Use current settings as my default...** -- Check this box if you have changed tolerance policy settings and want these settings to be the default settings for all future (new) cost components.

### To edit the tolerance policy for a component

- 1 Open the **Tolerance Policy Editor** as described in the previous procedure.
- 2 Click the **Use the following values:** radio button and enter values for the tolerance and/or roughness settings you wish to control.

Use the following values:

Tolerance (coordinate) (in):

Roughness Ra ( $\mu$ in):

Roughness Rz ( $\mu$ in):

Diam Tolerance (in):

True Position (in):

Bend Angle Tolerance (deg):

Circularity (in):

Concentricity (in):

Cylindricity (in):

Flatness (in):

Parallelism (in):

Perpendicularity (in):

Profile of Surface (in):

Runout (in):

Total Runout (in):

Straightness (in):

Symmetry (in):

Refer to the table in [How tolerances map to GCDs](#) for information about specific settings.

- 3 Click **OK** to apply changes, recalculate the cost, and close the **Tolerance Policy Editor**.  
You can also click **Apply** to apply changes and recalculate the cost without leaving the **Tolerance Policy Editor**.

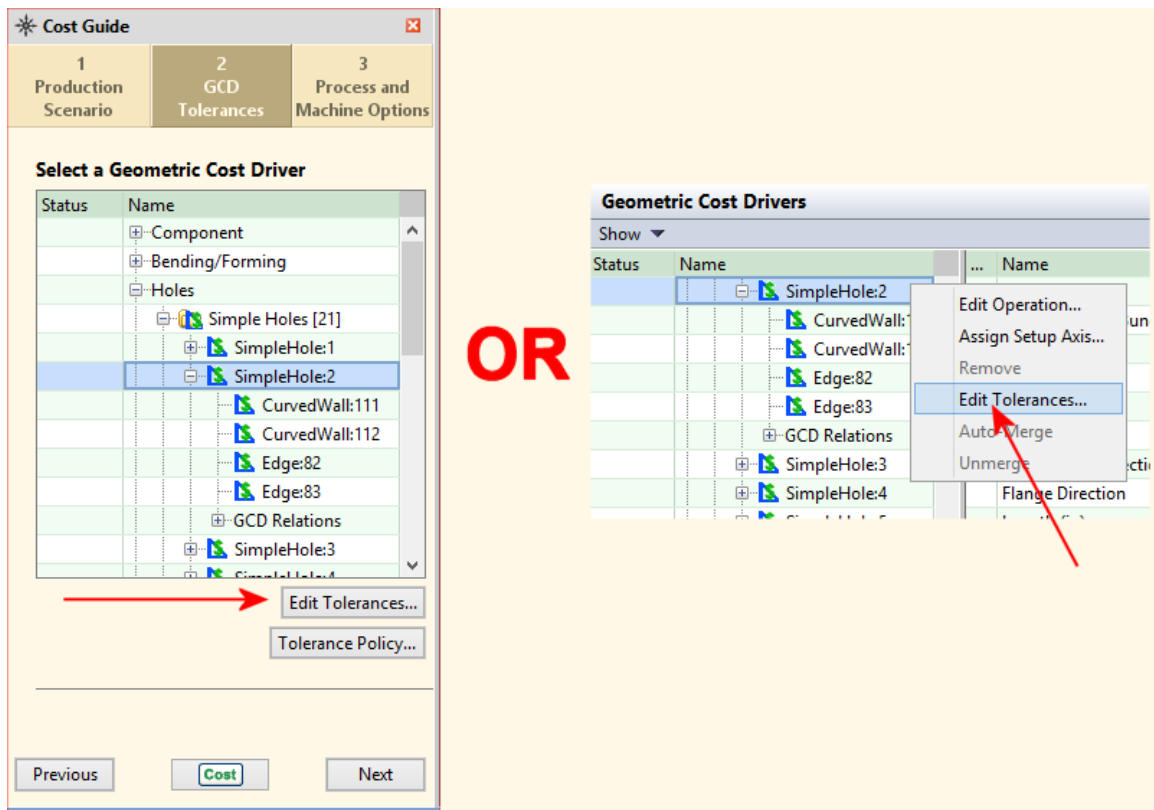
## Manually editing specific tolerances

You can enter individual values for tolerance and roughness fields for a specific GCD. You can edit these tolerances in one of two ways:

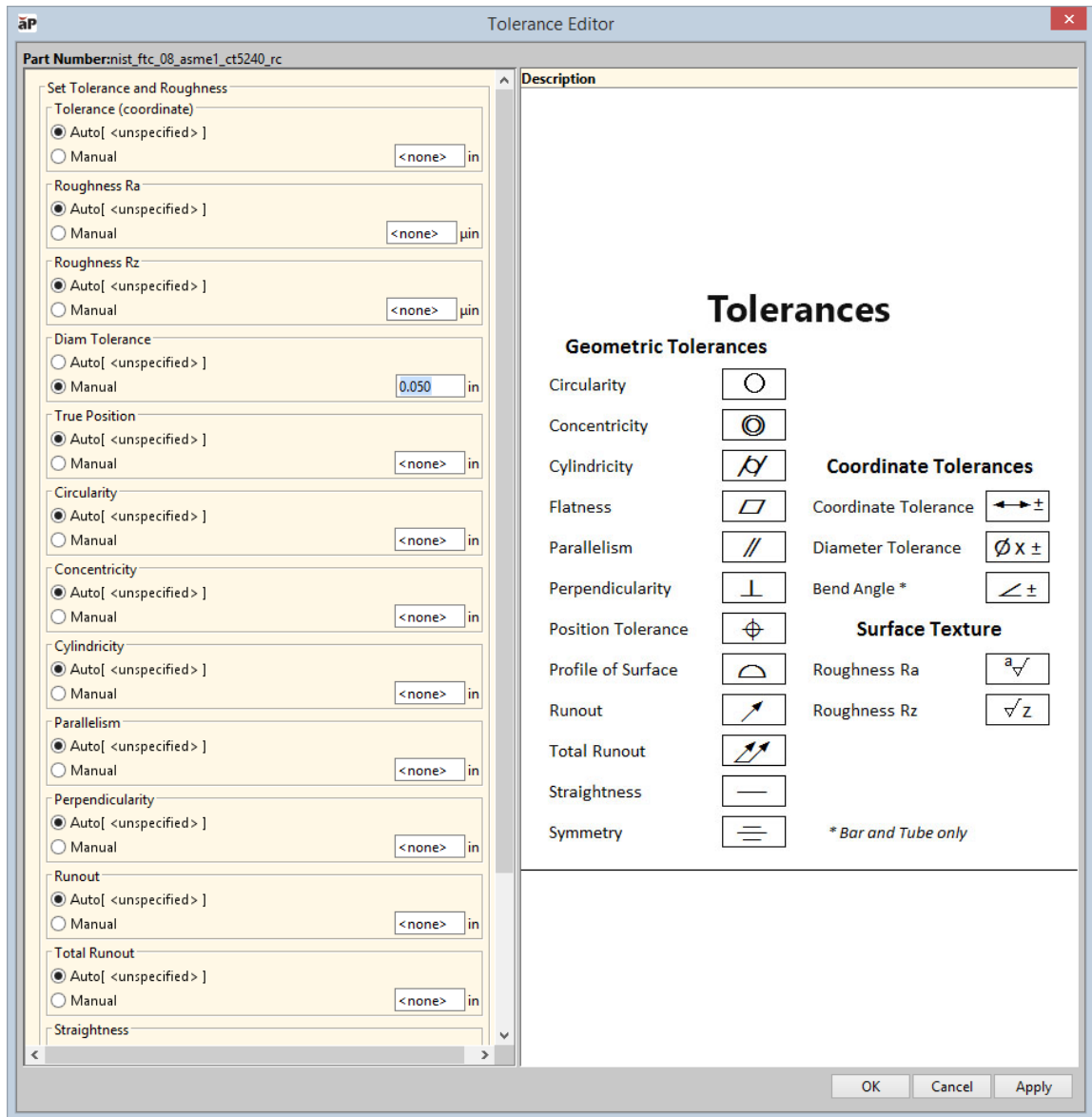
- From the **Tolerance Editor** (not to be confused with the **Tolerance Policy Editor** described in the previous section).
- From the editable tolerance and roughness fields in the **Geometric Cost Drivers** pane.

### To enter tolerance and roughness values using the Tolerance Editor

- 1 There are two ways to open the **Tolerance Editor**. Select a GCD either:
  - From the middle tab of the **Cost Guide**, and click the **Edit Tolerances** button, or
  - From the **Geometric Cost Drivers**, and select **Edit Tolerances** from the right-click context menu.



- The **Tolerance Editor** displays, showing a list of tolerances that apply to that type of GCD (see the table in the section [How tolerances map to GCDs](#) for more information).



- For the tolerance value(s) that you wish to set, click **Manual**, and enter the value in the associated field.
- Click **OK** when done.

**To enter tolerance and roughness values using the Geometric Cost Drivers pane**

- Go to the **Geometric Cost Drivers** pane and navigate to the GCD to which you wish to add tolerance information.

Geometric Cost Drivers			
Show ▾			
Status	Name	...	Property Result
	Component	Sleeve Pin Hole	false
	Bending/Forming	Cone Angle (deg)	90.00
	Holes	Tolerance (coordinate) (in)	<unspecified>
	Simple Holes [21]	Roughness Ra (µin)	<unspecified>
	SimpleHole:1	Roughness Rz (µin)	<unspecified>
	SimpleHole:2	Diam Tolerance (in)	<i>0.05000</i>
	SimpleHole:3	True Position (in)	<unspecified>
	SimpleHole:4	Circularity (in)	<unspecified>
	SimpleHole:5	Concentricity (in)	<unspecified>
	SimpleHole:6	Cylindricity (in)	<unspecified>
	SimpleHole:7	Parallelism (in)	<unspecified>
	SimpleHole:8	Perpendicularity (in)	<unspecified>
	SimpleHole:9	Runout (in)	<unspecified>
	SimpleHole:10	Total Runout (in)	<unspecified>
	SimpleHole:11	Straightness (in)	<unspecified>
	SimpleHole:12	Symmetry (in)	<unspecified>
	SimpleHole:13	Threaded	false
	SimpleHole:14	Thread Length (in)	-
	SimpleHole:15	Volume (in^3)	0.02
	SimpleHole:16	Removed Volume (in^3)	0.02
	SimpleHole:17	Surface Area (in^2)	0.30
	SimpleHole:18	Min Wall Thickness (in)	-

The **Name** column lists the tolerances that apply to this GCD (along with other values). See the table in the section [How tolerances map to GCDs](#) for more information.

The pencil icon indicates fields that can be edited.

- 2 Double-click the field in the **Property Result** column to enter the value you wish to apply.

Note that override values are displayed in red italic and a green “User Override” icon appears in the left column.

- 3 To remove an existing tolerance value, you can double-click and delete the entered value, or right-click the value and select **Return to Auto-Select** from the context menu to re-display *unspecified* in the field.
- 4 Press **Enter**, **Tab**, or click on another property.

## Importing PMI from CAD

aPriori supports the import of certain *semantic* Product Manufacturing Information (PMI) values defined in supported CAD systems. PMI is often added to CAD models to specify non-geometric attributes necessary for the correct manufacturing of the part. These can include Geometric Dimensioning and Tolerancing (GD&T), surface texture specifications, etc.

Two flavors of PMI exist:

- Non-semantic or “graphical” PMI – This is an older implementation and is simply the addition of displayable textual annotations (represented by lines and characters) to the CAD model. These annotations are human-readable but are usually not fully associated with the underlying part geometry in machine-readable form.
- Semantic PMI – These annotations are implemented as CAD model metadata in a well-defined and machine-readable (as well as human-readable) fashion.

**Note:** aPriori only reads semantic PMI. (There are some minor, CAD-system-dependent exceptions to this blanket statement. But in general, you can only import semantic PMI annotations into aPriori.)

It can be difficult to determine if an annotation visible in a CAD model is semantic or non-semantic, so most CAD systems provide ways of flagging non-semantic PMI annotations, such as appending a red squiggly line beneath the annotation.

A complete discussion of PMI is far beyond the scope of this aPriori document. You must consult the documentation and Support resources for your CAD system regarding how to properly construct and identify semantic vs. non-semantic PMI in CAD models. Note that some CAD systems may require you to acquire and install an additional module for creating PMI annotations. For example, CATIA requires that you have access to their Functional Tolerancing and Annotation module.

For more information, refer to:

- Reputable third-party sites such as the National Institute of Standards and Technology (NIST, <http://www.nist.gov>).
- The PMI sections of the documentation, training, and Support resources for your CAD system(s)
- [Notes about specific CAD systems and PMI](#), later in this chapter.

### aPriori Support for PMI

As of Release 2018 R1 (18.1), aPriori supports importing certain semantic PMI values from the following CAD systems:

- CATIA
- Creo
- NX
- SolidWorks

**Note:** As noted earlier, there are a couple of non-semantic PMI annotations that aPriori can import, such as Diameter and Roughness annotations. However, in general if aPriori encounters non-semantic PMI when reading a CAD model, it logs the presence for diagnostic purposes, but does not store the information or attempt to use it for costing.

The following types of PMI are generally supported, with some restrictions for different CAD systems:

- Diameter tolerances
- Most geometric tolerances



- Surface Roughness Ra & Rz
- “Virtual” Threads/Taps (see [Notes about virtual threads and taps](#) below)

aPriori takes the imported PMI data and applies it to the appropriate GCDs for costing. (See Chapter [8. Geometric Cost Drivers](#).) You control PMI import behavior through the Tolerance Policy Editor.

### Notes about virtual threads and taps

Although threaded hole information does not fall under the category of tolerance or roughness annotations, it is imported from the CAD model to aPriori using the same mechanism.

**Note:** In general, aPriori currently does not import PMI from Assembly models, just part models. This includes thread information for holes created as assembly features rather than part-level features. However, if you are working in the Creo Direct Integration version of aPriori, information about threaded holes made as assembly-level features is provided to aPriori. In all other cases, users will have to indicate that these holes are threaded inside the aPriori application.

Each supported CAD system supports multiple ways to specify that a hole or shaft is threaded, without actually modeling the threads (hence the term “virtual”). The concepts are the same across the different CAD systems, although the ways they are implemented differ.

In general, CAD systems offer two ways to specify virtual threads:

- As a property or set of properties of a hole feature, typically implemented as a checkbox that says “threaded”, plus fields for entering other data such as thread length or depth, pitch, etc.
- As a separate distinct feature. These features are named differently in different systems:
  - CREO: “cosmetic thread”
  - Catia: “thread/tap feature”
  - NX: “symbolic thread”
  - SolidWorks: “cosmetic thread”, “tapped hole”

aPriori currently supports all these methods EXCEPT SolidWorks thread and tapped hole information.

In addition, aPriori Direct Integration mode (see [Direct Integration mode](#)) supports both property and feature approaches for CREO.

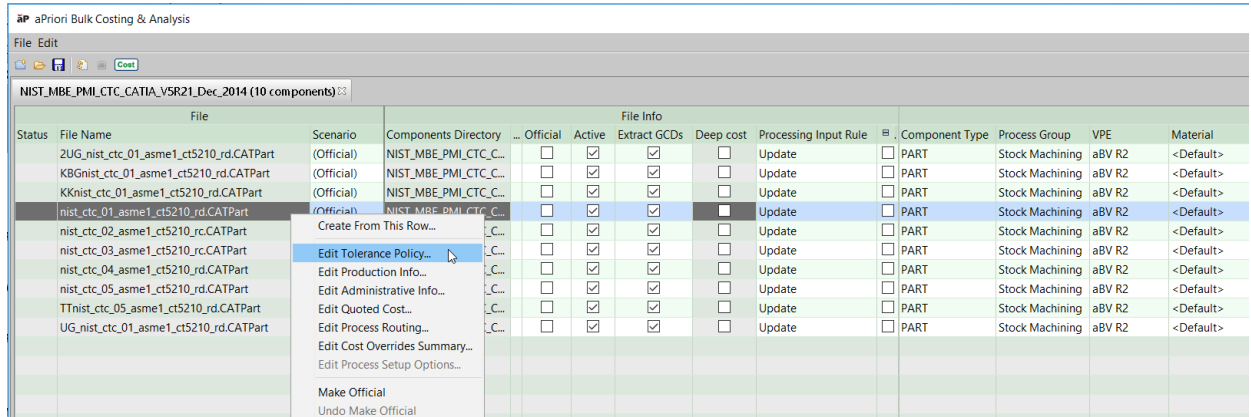
Regardless of how you import virtual thread information, aPriori costs them simply based on the fact that the hole is threaded and uses the diameter and the thread length to compute cycle time. Any other data such as thread pitch is ignored. In summary, only a subset of thread metadata which may exist in a CAD model is actually imported into aPriori and used to calculate cost.

### Importing and reviewing PMI from CAD

Supported semantic PMI annotations are imported to aPriori when you open or refresh a supported CAD file **IF** you set the **Use CAD model values...** checkbox in the **Tolerance Policy Editor**. You **must** set this checkbox to import semantic PMI information from a CAD model, otherwise it will be ignored.

Use CAD model values\* (\*valid only for diametrical tolerances and GD&T specified in CATIA, NX, and ProEngineer/Creo models)

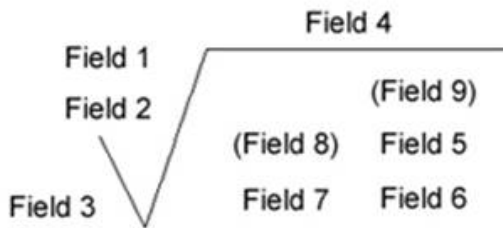
**Note:** The following sections describe how to import PMI with the interactive aPriori client. For Interactive Bulk Costing, you must set the Tolerance Policy for the Bulk Costing run, for all or selected scenarios. Tolerance Policy cannot be specified from the command line or the input spreadsheet in aP 2016 R2.



### How aPriori imports roughness (Ra and Rz) values

CAD systems provide a variety of ways to completely specify Roughness. aPriori has observed inconsistent use of the available Roughness inputs across our customer base. Therefore, we have adopted a specific method for processing and interpreting the incoming roughness data found in a CAD file, as described below. Note that Roughness import is NOT supported for SolidWorks.

Up to nine Roughness Related fields may be populated, across the varying CAD systems supported by aPriori:



where:

- Field 1: Roughness value Ra
- Field 2: Unused
- Field 3: Minimum material removal
- Field 4: Production method
- Field 5: Roughness cutoff
- Field 6: Roughness value other than Ra (e.g., Rz)
- Field 7: Direction of lay

- Field 8: Rarely used.
- Field 9: Rarely used.

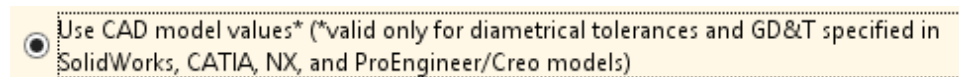
aPriori looks at any values defined in these nine fields according to these rules:

- 1 Find all fields that look like "Ra number" (case insensitive and ignoring whitespace around "Ra" and around the number).
- 2 Find all fields that look like "Rz number" (case insensitive and ignoring whitespace around "Rz" and around the number).
- 3 If Ra and/or Rz is found then aPriori uses the smallest value of each for the GCD properties.
- 4 If neither Ra nor Rz is found then aPriori tries to parse the contents of Field 1 and Field 6 as numbers. Field 1 contains "Roughness value Ra", Field 6 contains "Roughness value other than Ra". aPriori uses any number in Field 1 for the RoughnessRa property and any number in Field 6 for the RoughnessRz property.

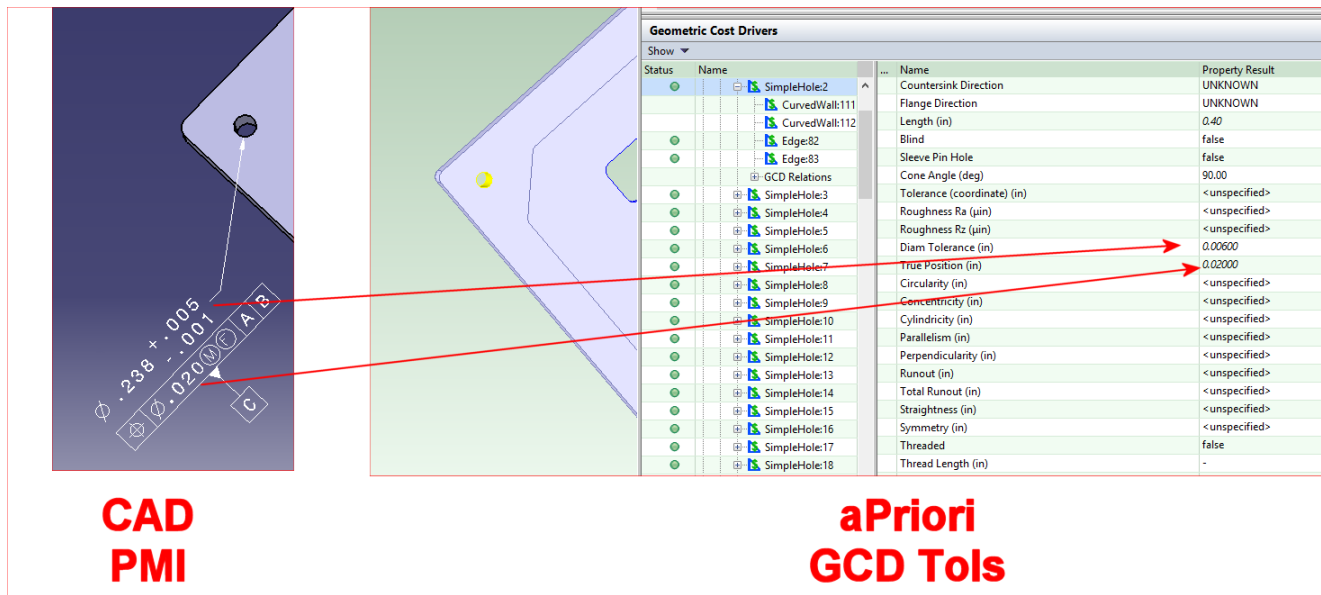
For example, if Field 1 (the nominal Roughness Ra field) is populated with "32" and Field 5 (the Roughness Cutoff field) is populated with "Ra 64", aPriori will use Field 5 since it contains the Ra string and Field 1 does not, even though the VALUE of Field 5 is larger than the value of Field 1.

### To import PMI

- 1 Open the **Tolerance Policy Editor**.as described in [To open the Tolerance Policy Editor](#).
- 2 In the **Tolerance Policy Editor** click the **Use CAD model values...** radio button.



- 3 Click OK, then Cost the model.
- 4 To confirm that the expected PMI values have been correctly imported, go to the **Geometric Cost Drivers** pane and navigate to a GCD that should have the PMI value from the CAD model.



In this example, note that the “+.005/-0.001” CAD PMI tolerance appears in aPriori as a total “.006” tolerance.

### Troubleshooting PMI

aPriori can write entries to the log file whenever it encounters a PMI attribute that it cannot map to a GCD. The following messages are “WARN” level and by default are written to the log file:

```
<PMI NAME> ignored because it is specified on an inactive surface,
<PMI NAME> was not associated with any GCDs, and
<PMI NAME> was not used because it is not semantic and has no
magnitude. It would have been associated with GCD(s) <LIST OF GCDs>
```

To reduce the number of entries written to the log files, several other PMI messages are only written if the logging is set to DEBUG level.

#### To set DEBUG-level logging for PMI:

- 5 Open `<apriori_install>/log4j.properties` in an editor.
- 6 Add the following line: `log4j.logger.com.fbc.util.cad.pmi.PmiLog=debug`
- 7 Save the file and restart aPriori.

#### To view PMI log messages:

- 8 Click **Help > Explore Logs Directory**
- 9 Open `apriori.log` in a text editor. Search for entries starting with `PmiLog`. These messages contain information that allow you to identify the PMI attribute that failed and the nature of the failure. For example:

```
DEBUG PmiLog:285 - [Dim tolerance NIST PMI FTC 06 ASME1|Annotation Set.1|Linear
Size.30 LINEAR 7.9375[-0.508:0.508]] were ignored because aPriori currently does
not support non-radial/diametrical dimensional tolerances.
```

Since aPriori imports only semantic PMI, and since it is not always easy to identify semantic vs non-semantic PMI in a CAD system, aPriori logs entries similar to the following when it encounters non-semantic PMI attributes:

```
WARN PmiLog:285 - Gtol turning|Annotation Set.1|Geometrical Tolerance.13 [SYMMETRY
-1] Note:.0005|| is not semantic
```

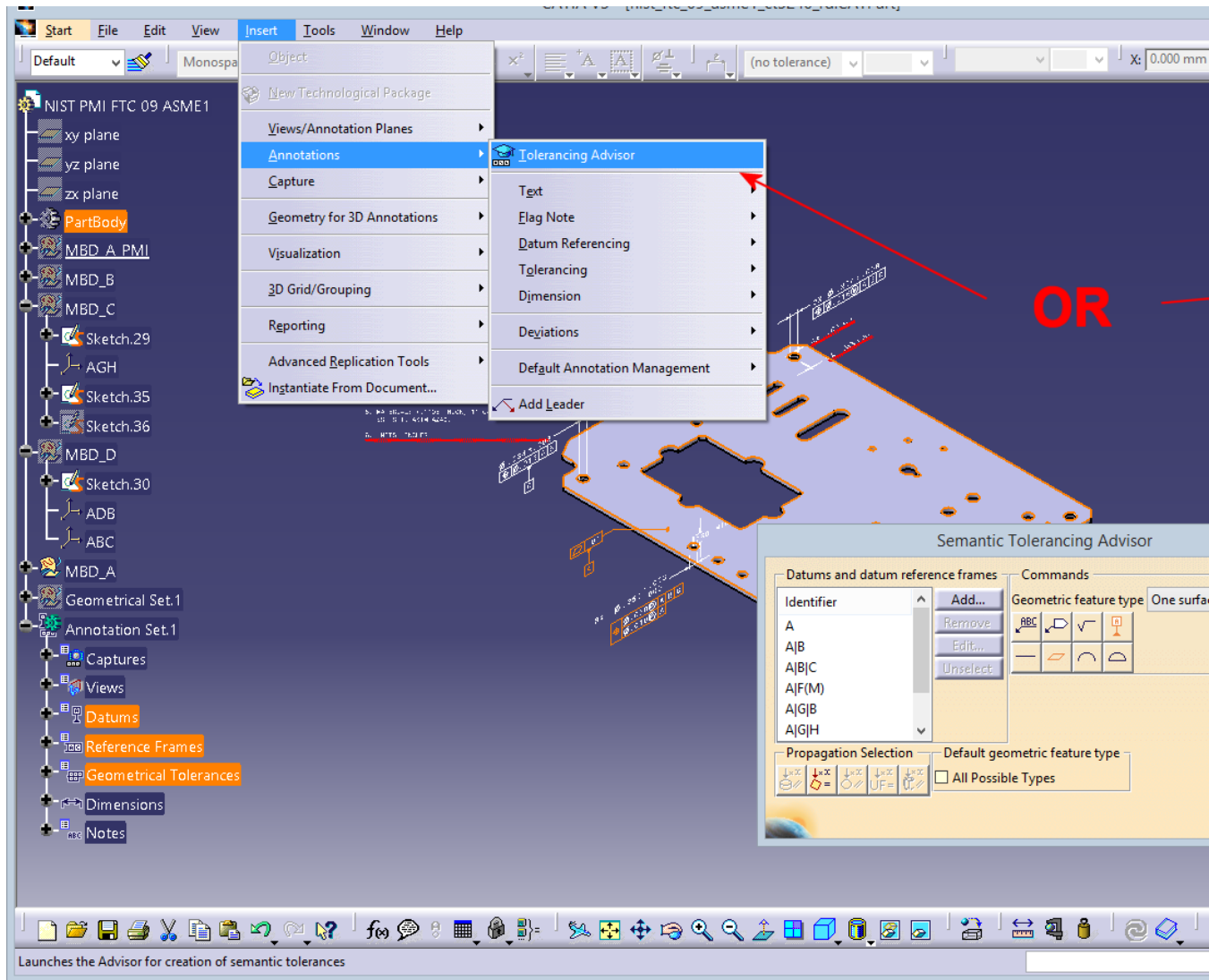
## Notes about specific CAD systems and PMI

Details about implementing PMI attributes within various CAD systems is far beyond the scope of this aPriori documentation. aPriori encourages you to get expert guidance regarding best practices for creating semantic (machine-readable) PMI from your CAD vendor, particularly since CAD vendors are also making enhancements in this area of functionality. However, we have found some hints they may help you get started in identifying and creating PMI attributes in your CAD system that can be imported into aPriori.

### CATIA

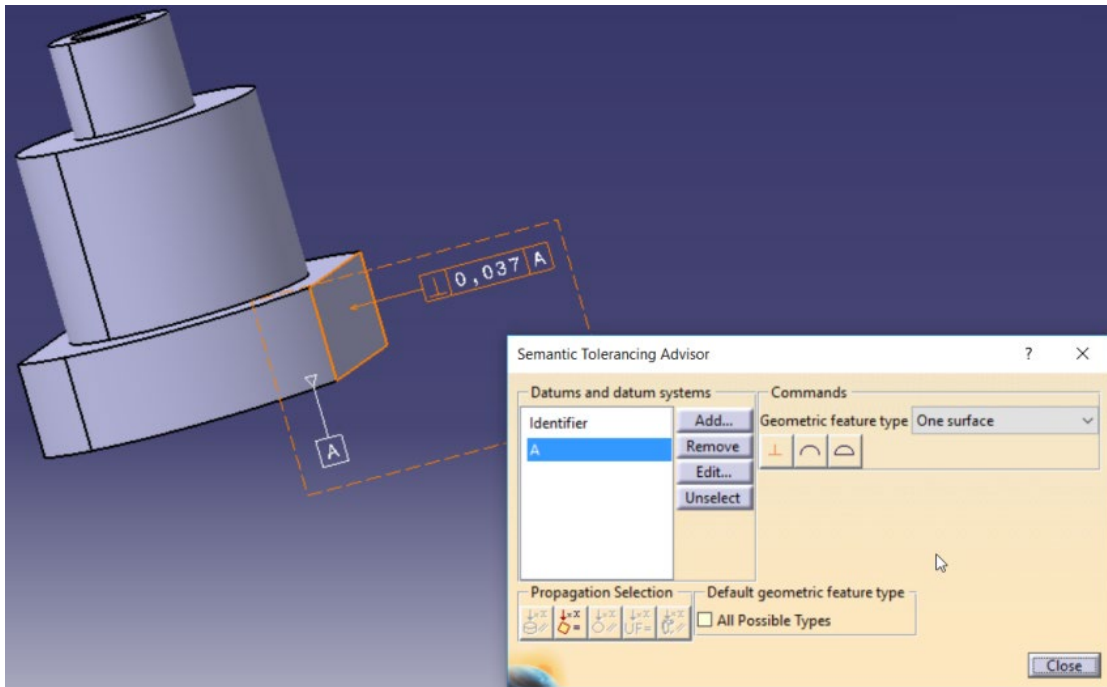
The following notes may help you to create PMI annotations in CATIA that can be imported into aPriori.

- 1 Creating Semantic PMI in CATIA generally requires the separately-licensed Functional Tolerancing and Annotation (FTA) module. Once this is installed, you can turn on tolerance toolbar options by clicking **Start > Mechanical Design > Functional Tolerancing & Annotation**. (Do not click the similarly-named “**Product Functional Tolerancing & Annotation**” option higher on the same menu. This option will make your part disappear.)
- 2 To enter semantic PMI in CATIA, select a surface and then click either **Insert > Annotations > Tolerancing Advisor**, or click the **Tolerancing Advisor** icon in the toolbar.

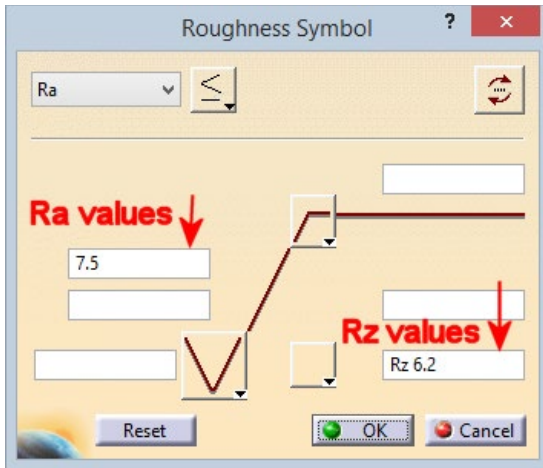


**Note:** If you use a different path or command to enter tolerance annotations (for example, **Insert > Annotations > Tolerancing > Geometric Tolerance**), you will generally be creating non-semantic PMI and the dialog titles will not say “Semantic”. The annotations you are create will typically not get imported into aPriori. However, see the next section for an exception.

The **Semantic Tolerancing Advisor** dialog allows you to create various types of GD&T annotations that are appropriate for the selected surface/entity. Some types of callouts need you to indicate a datum reference. Once you do so, more types will be available for selection. In the following example, a planar surface is selected, and datum reference A is selected in the Advisor. As a result, the possible valid callouts are Perpendicularity, Profile of Line, and Profile of Surface. Parallelism is not presented, because CATIA knows that datum A (the bottom surface of the part) is not parallel to the selected surface.



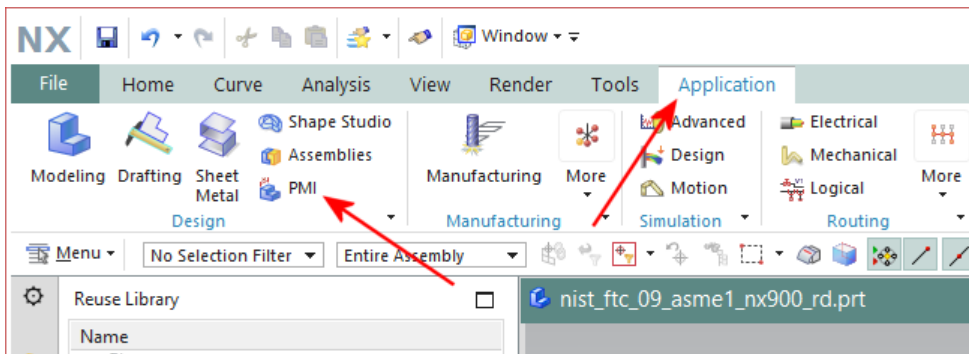
- 3 As mentioned above, there are some exceptions to the rules that only semantic PMI can be imported to aPriori from CATIA, or that using the procedures above will ONLY create one type or the other:
  - **Roughness** – Roughness annotations in CATIA are non-semantic but aPriori is able to parse these annotations if they match certain patterns and in many cases is able to import them.
  - **Flatness and Cylindricity** – Some CATIA GD&T callouts defined using the “non-semantic” menu path (**Insert > Annotations > Tolerancing > Geometric Tolerance**) actually produce semantic PMI that can be imported by aPriori. These appear to be “single surface” types that do not require multiple surfaces or datum references.
- 4 **Best practices for entering roughness values:** -- Ra roughness values should be entered in the upper-left field; Rz values should be entered in the lower right field. If roughness numbers are entered in these fields, you do not need to use the “Ra” and “Rz” prefixes.



See [How aPriori imports roughness \(Ra and Rz\) values](#) above for more information.

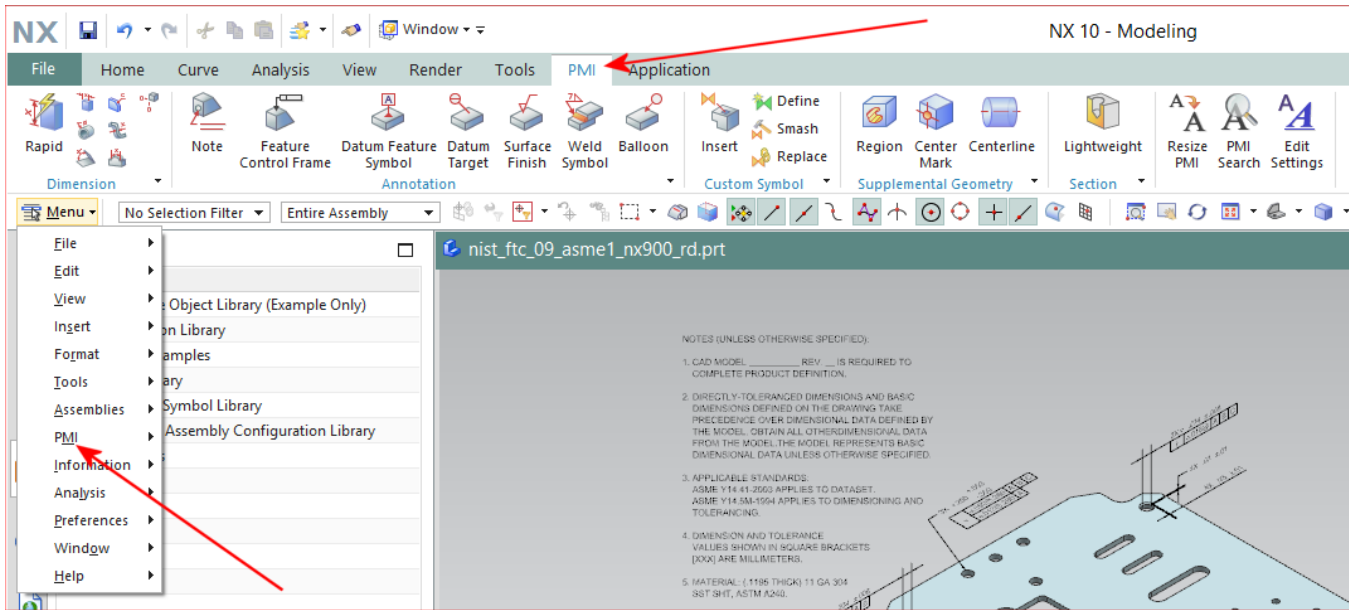
## NX

- 1 To turn on PMI in NX, go to the **Application** tab and click **PMI**:

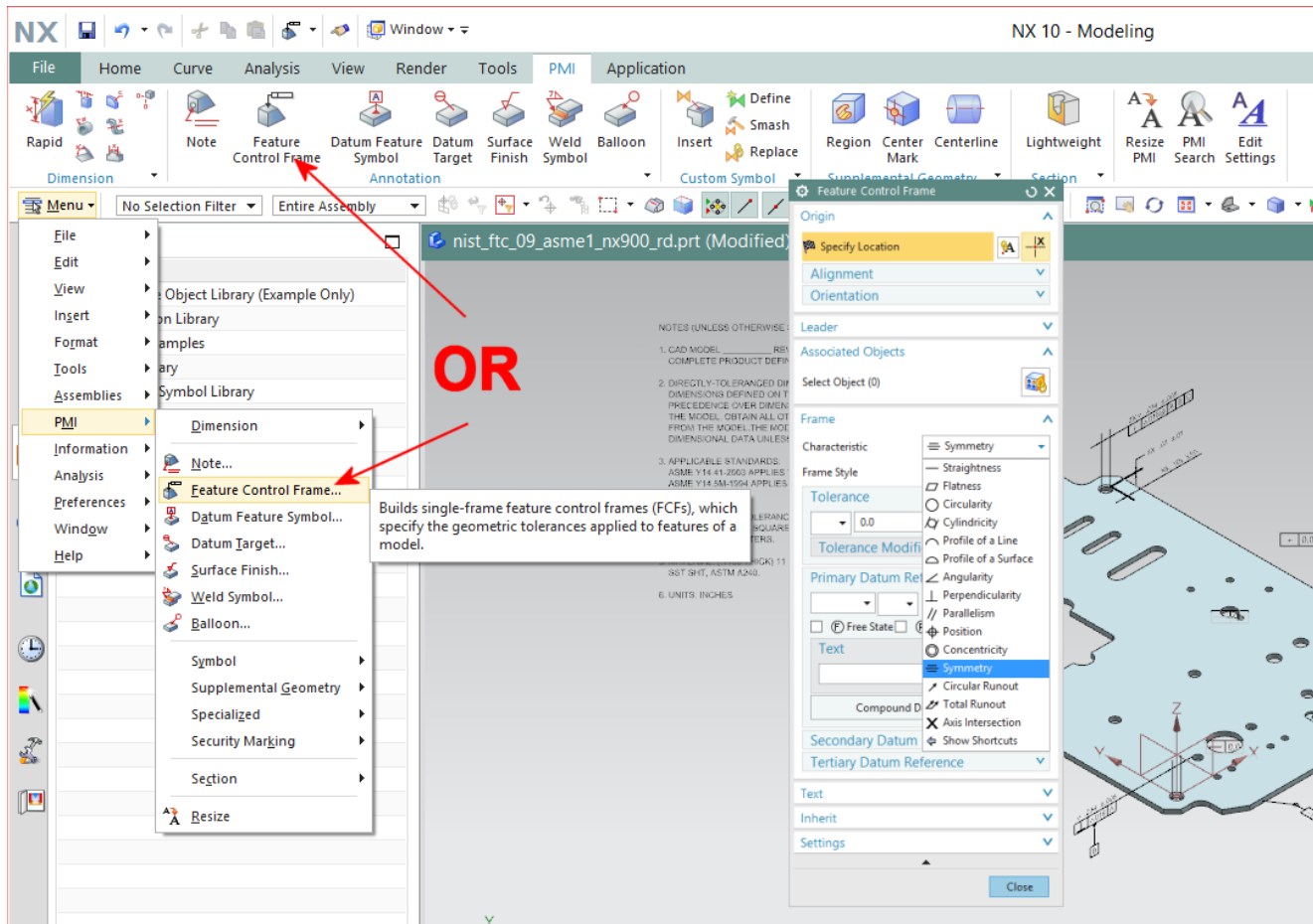


- 2 Once PMI is enabled, you can access PMI capabilities from the **PMI** tab and from the **PMI** menu item on the main drop-down menu:



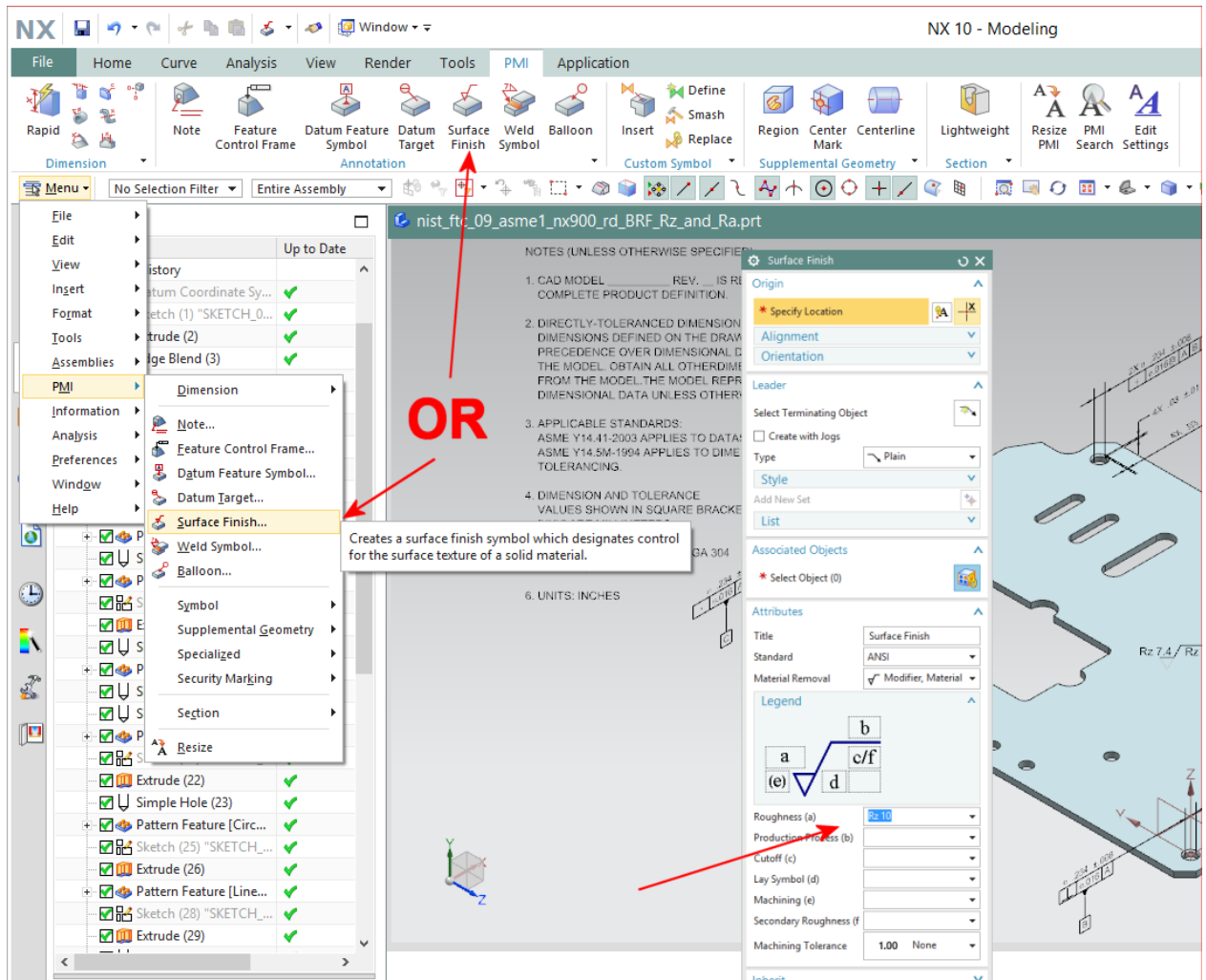


- To specify and apply geometric tolerances to model features, click either the **Feature Control Frame** icon in the tool bar, or **Menu > PMI > Feature Control Frame**, then fill in the fields on the **Feature Control Frame** dialog.



It is important to use the **Associated Objects** control to select the correct geometry reference (typically a surface or a hole) and associate it with the annotation you are creating. Note that aPriori does not read PMI associated on edges.

- To specify and apply roughness requirements to model surfaces, click either the **Surface Finish** icon in the tool bar, or **Menu > PMI > Surface Finish**, then fill in the fields on the **Surface Finish** dialog. Enter use the **Roughness (a)** field. If the value that you want is not provided by the drop-down menu, type in the value such as “Ra 1.5” or “Rz 10”.



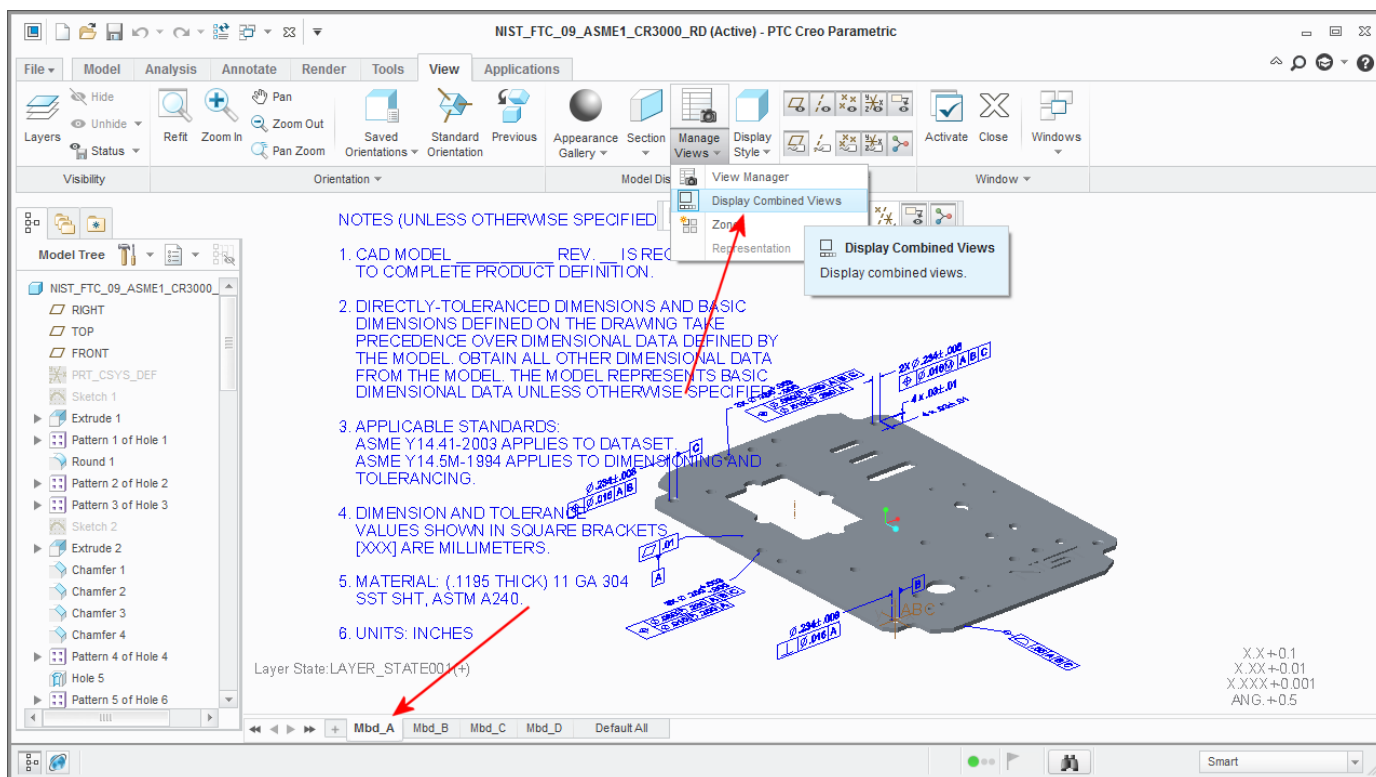
As mentioned with above for GD&T PMI, you must use the **Associated Objects** control to select the correct geometry reference and associate it with the roughness annotation you are creating.

## Creo

**Deprecated functionality (Creo direct integration only):** Prior to Release 2016 R2, aPriori extracted linear size/position tolerances, but assigned them to more faces than intended. (For example, the tolerance on the dimension callout between two opposing sides of a rectangular block would be imported into aPriori but applied to all faces of the block). In Release 2016 R2, aPriori no longer extracts linear size/position tolerances, but now extracts Diameter tolerance, Surface Roughness, cosmetic threads, and GD&T callouts

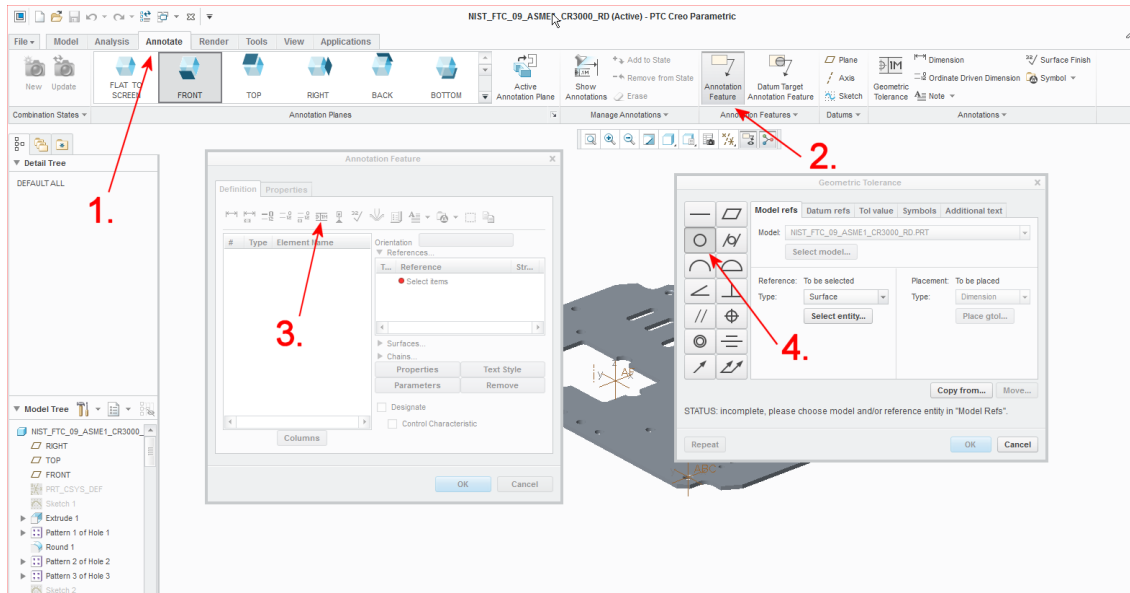
**Displaying existing annotations --** By default Creo turns off the display of most annotations to simplify the display. If you are opening a part that contains PMI (such as the NIST PMI test models available from <http://www.nist.gov>) you may need to turn on the display of these annotations. Using a NIST test part as an example:

Go to the **View** tab, then click **Manage Views > Display Combined Views**. At the bottom of the screen, click **Mbd\_A**.

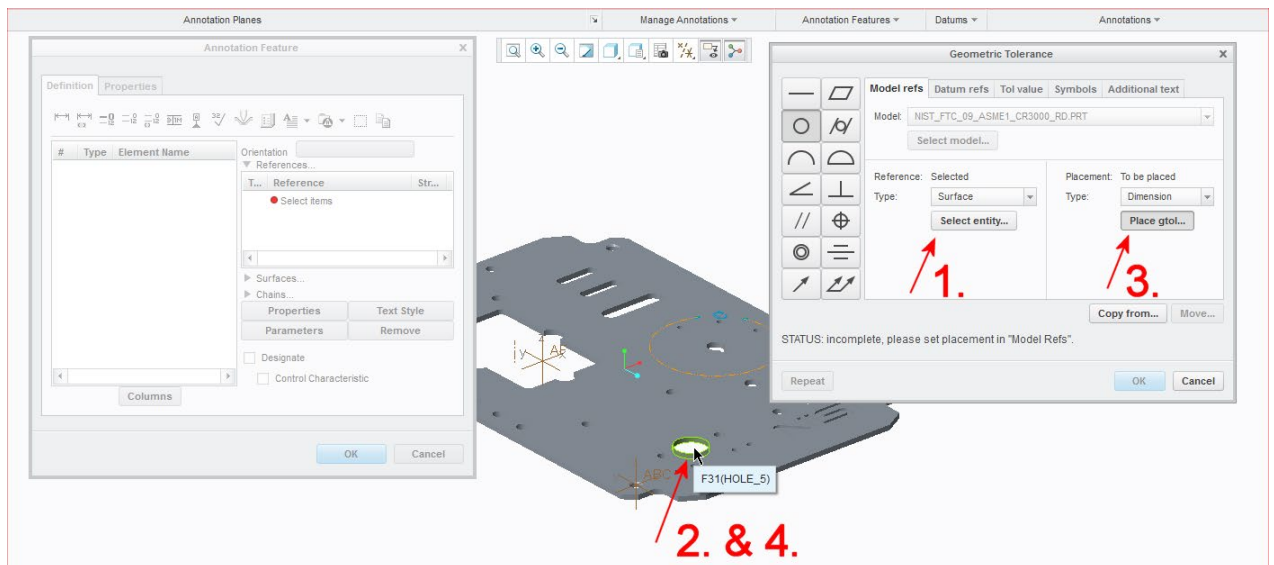


**Creating tolerance annotations in Creo --** Creating PMI annotations in Creo requires that you select surfaces and locations in a very specific order. The initial steps are fairly intuitive, but the final steps can be less than obvious, and you can end up with one or two dialog boxes open with no clear direction as to how to complete the operation. The following steps walk you through an annotation procedure. Note that this is not necessarily the best or only way to add a geometric tolerance to a Creo model. It is intended only as a sample path to help users exploring this functionality for the first time. Please refer to official Creo technical support, training, and documentation resources for recommended procedures and best practices.

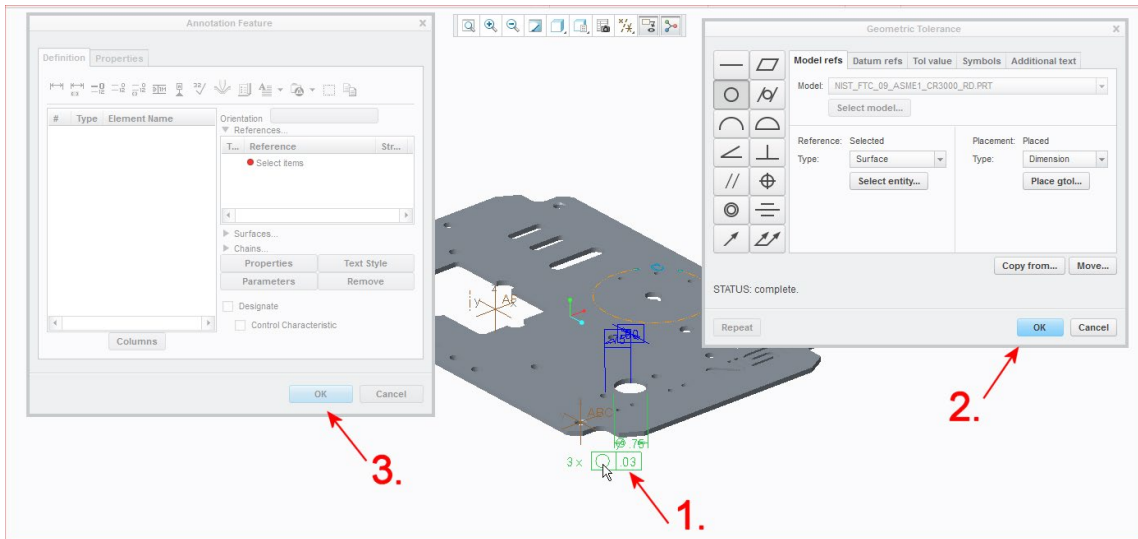
- 1 Click the **Annotate** tab (1), then click **Annotation Feature** (2). In the Annotation Feature window, click the **“Geometric Tolerance”** icon (3), and in the Geometric Tolerance window, click the type of annotation you wish to create – in this example, **“Circularity”** (4).



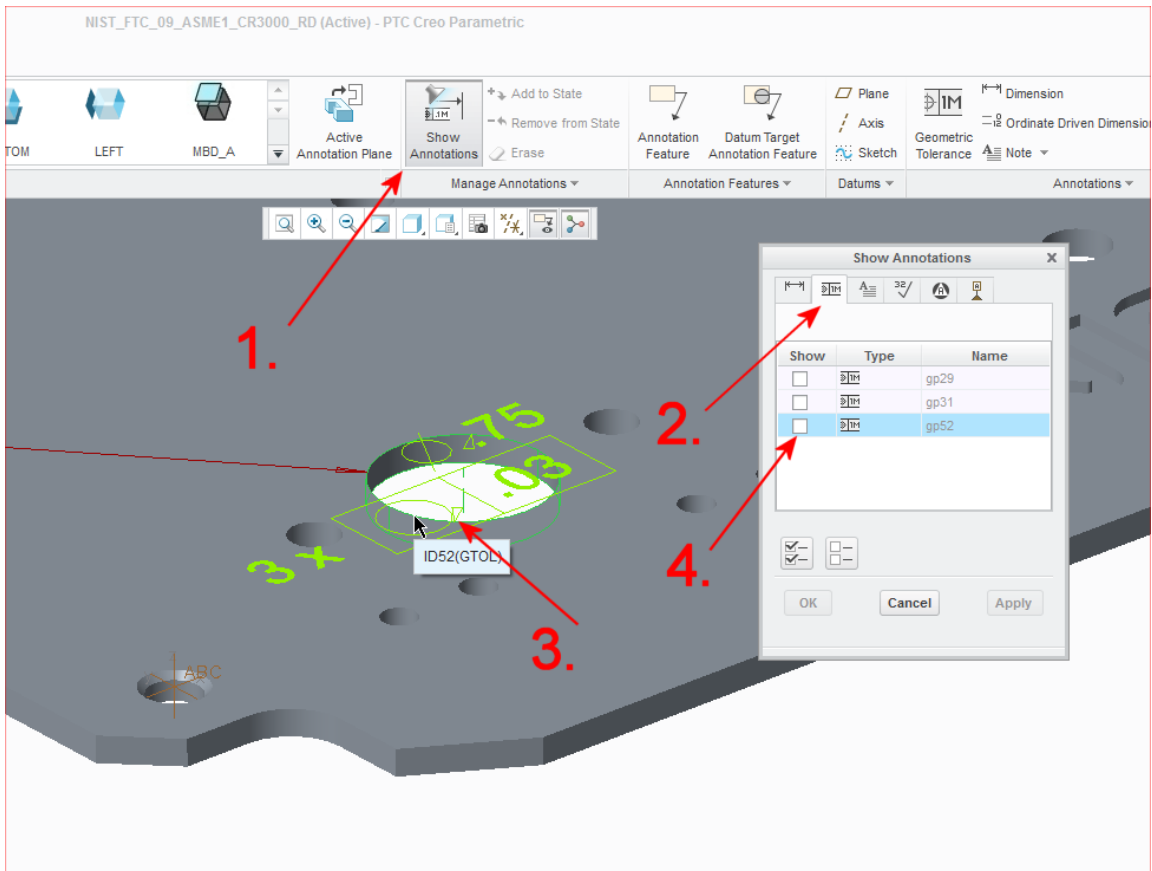
- 2 In the **Geometric Tolerance** dialog box, click **Select entity** (1), then click the surface to be associated with the tolerance (2). Then click **Place gtol** (3) and again click the associated surface (4).



- 3 Select the dimension that was just added to the surface, and then click **Ok** in both the **Geometric Tolerance** dialog box and the **Annotation Feature** dialog box.



- 4 When you finish creation of the annotation, you may need to explicitly turn on its display. If so, click **Show Annotations** (1), then click the **Geometric Tolerances** tab in the **Show Annotations** dialog (2), click the annotation you wish to display (3), and select its checkbox (4). Click **Ok** when done.



## SolidWorks

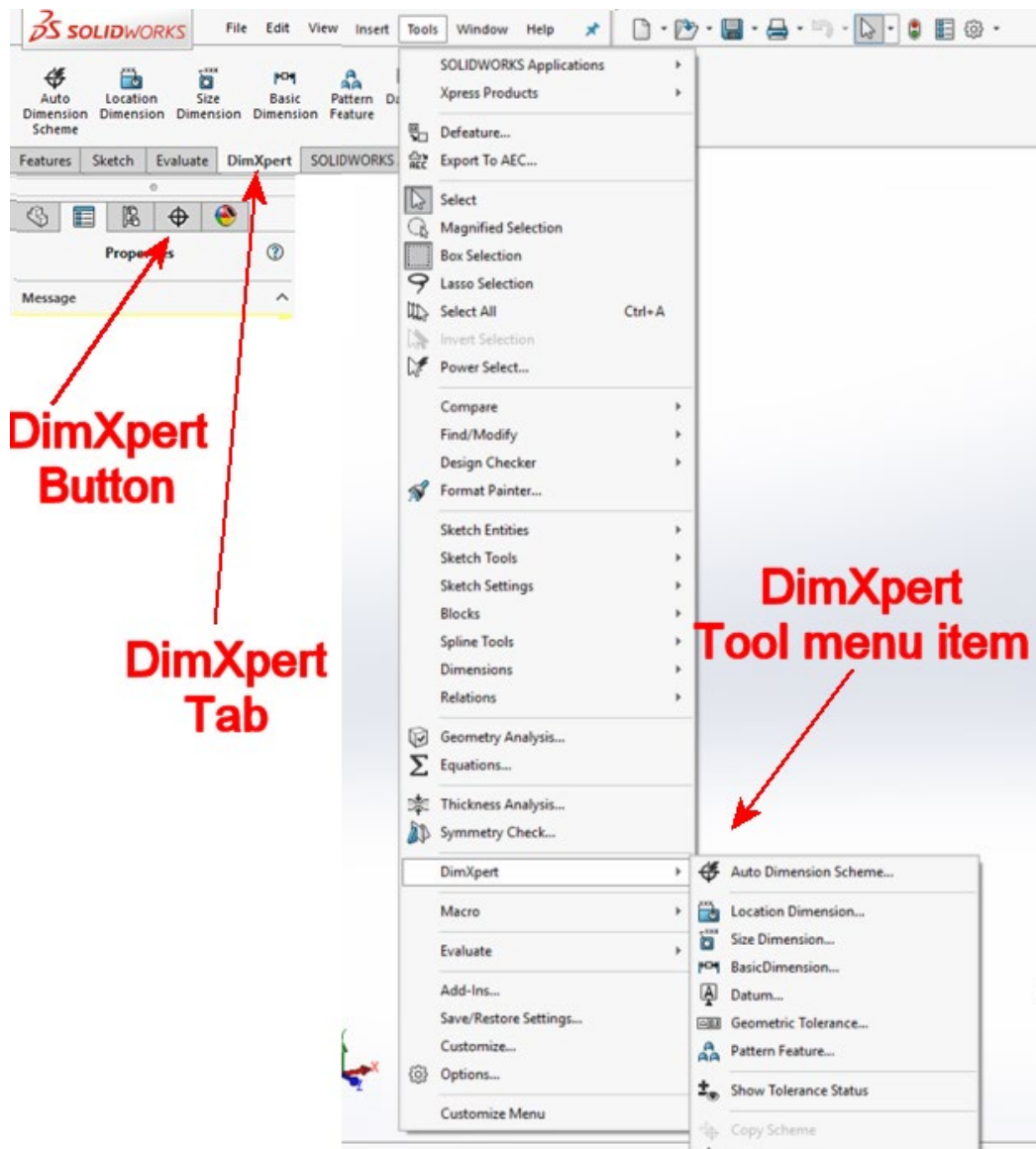
aPriori supports importing PMI from SolidWorks as of Release 2018 R1.

**Note:** aPriori does not support the import of roughness or virtual thread/tap PMI from SolidWorks.

The following information is based on SolidWorks 2016 and 2017.

The primary way to create PMI items in SolidWorks is to use the **DimXpert** tool, which enables you to create dimensions in 3D space on the 3D model (similar to creating 2D dimensions on a 2D drawing). Note that DimXpert does not allow you to create different views with only certain dimension shown. That is done with SolidWorks MBD. The dimensions and annotations that DimXpert creates are not *driving* dimensions, but *driven* dimensions. They are not created when the features are created.

- 5 Open the model you want to dimension in SolidWorks.
- 6 Either click the **DimXpert** tab or click the **Tools > DimXpert** menu item.



- 7 Use the options on the toolbar or on the menu to create PMI. However, note that not all of these options create *semantic* PMI. The following table identifies which options create semantic PMI.

Item Type	Sematic?
<b>Dimensions</b>	Yes
<b>Datums</b>	Yes
<b>Geometric Tolerances</b>	Yes
<b>Datum Targets</b>	No
<b>Notes (including thread Callouts)</b>	No
<b>Surface Finish Symbols</b>	No
<b>Balloons</b>	No
<b>Weld Symbols</b>	No

## Editing yields

aPriori allows you to enter yield information to more accurately reflect the cost of waste due to bad parts or to material that is discarded during the manufacturing process. This yield feature is available in all process groups.

### Good Part Yield and Final Yield

For any process, you can specify a *Good Part Yield* or *GPY* (sometimes referred to as *Throughput Yield* or *TPY*) value that represents:

# parts out/# parts in

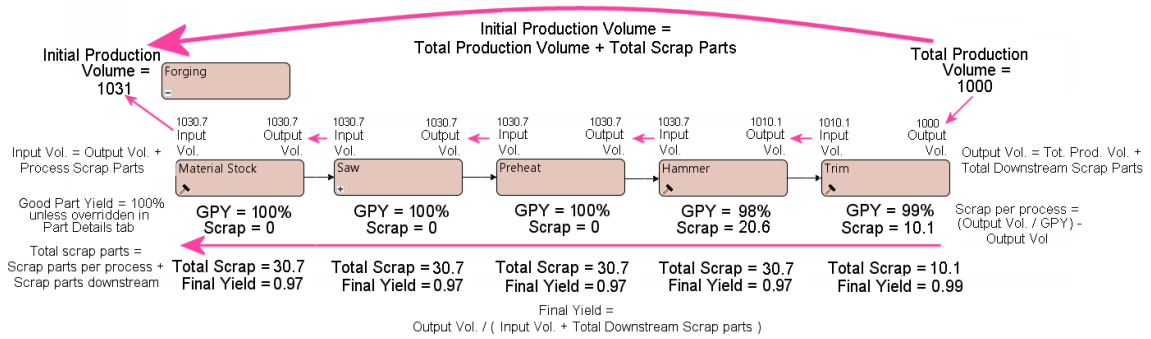
Default GPY values are stored as machine variables and can be overridden as percentage values in the **Part Details** tab as described below. By default, aPriori sets all Good Part Yield values to “1” (100%).

*Final Yield* (or *FY*) differs from Good Part Yield in that it is calculated for all downstream processes rather than just for the current process. Final yield is displayed in the **Part Details** tab and is used to calculate material cost.

Calculations involving yield values make use of production volume and the number of scrap parts at the process and routing level. Examples of scrap parts are damaged, broken, or out of tolerance parts. Note that aPriori does not include reworked parts in scrap calculations.

It is important to understand that yield calculations begin at the end of the routing, using the Total Production Volume as the starting point, and working upstream, process by process. The relationship of volume, scrap, and yield in the aPriori environment is summarized in the following illustration:



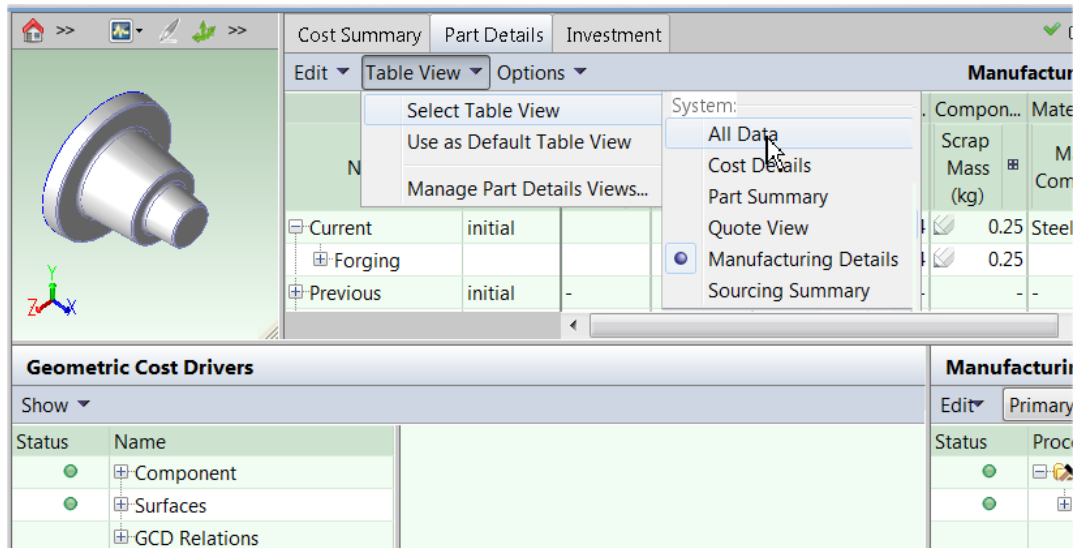


The end result of yield calculations is that the manufacturing process may require more material, direct labor, and direct overhead in each process.

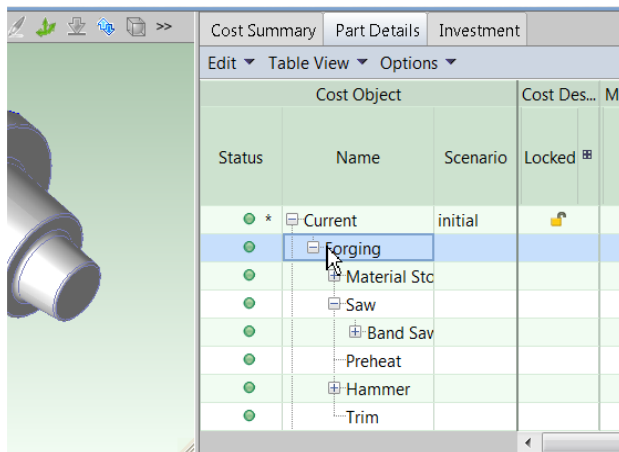
## Viewing and setting Good Part Yield values

To view the **Good Part Yield** column for a component:

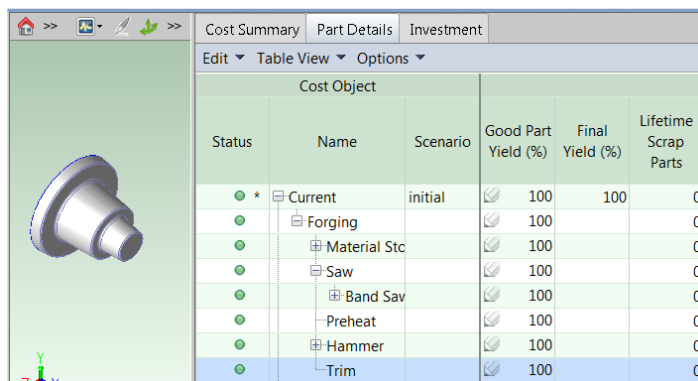
- 1 Go to the **Part Details** tab, and click **Table View > Select Table View > All Data**



- 2 In the **Cost Object** panel, expand all the processes.



- 3 In the **Manufacturing Info** panel, expand **Process Group**, and scroll to the right. The **Good Part Yield** column is just to the right of the **Labor** and **Overhead Rate** columns.



- Enter override values as necessary for specific processes. For example, to continue the values shown in the illustration above, you could enter “98” for the **Hammer** process row and “99” for the **Trim** process row. The **Final Yield** and **Lifetime Scrap Parts** columns update as you enter overrides. **Note:** You should not enter **Good Part Yield** values in any field except a process field, even if the field is editable.

Status	Name	Scenario	Good Part Yield (%)	Final Yield (%)	Lifetime Scrap Parts
● *	Current	initial	100	▲ 97	▼ 31
●	Forging		100		▼ 31
●	Material Stc		100		0
●	Saw		100		0
●	Band Sav		100		0
●	Preheat		100		0
●	Hammer		98		▼ 21
●	Trim		▲ 99		▼ 10

**Note:** The **Lifetime Scrap Parts** column sums up scrap parts at each node, but only processes are included in the total at “Current”, not nodes. The following modified example shows which values are actually included in the total.

Status	Name	Scenario	Labor Rate SD / hr	Overhead Rate (USD / hr)	Good Part Yield (%)	Final Yield (%)	Lifetime Scrap Parts
● *	Current	initial			100	97	▲ 32
●	Forging				100		▲ 32
●	Material Stc		0.00	0.00	100		0
●	Saw				100		▲ 11
●	Band Sav		25.85	19.19	99		▲ 11
●	Preheat		36.43	104.14	100		0
●	Hammer		32.40	84.34	98		▲ 21
●	Trim		32.40	36.28	100		0

Assume that you change the **Trim** process to 100% GPY, but change the **Band Saw** process under the **Saw** node to 99% GPY. The total scrap parts in this example changes to “0” for the **Trim** process, and “11” for the **Band Saw** process, which is also reflected on the **Saw** node row. However, only the process row “11” counts toward the **Current** total, not the node row “11”. An easy way to distinguish between node rows and process rows is that process rows always have labor and overhead rate values, while these columns are blank for node rows.

## Calculations related to yield

The following are yield calculations:

- **Num. of Scrap Parts = (Output Volume / Good Part Yield) – Output Volume**
- **Output Volume = Total Production Volume + Downstream Num. of Scrap Parts**
- **Input Volume = Output Volume + Num. of Scrap Parts (process-level)**
- **Downstream Num of Scrap Parts = Num. of Scrap Parts + Downstream Num of Scrap Parts**  
This calculates the sum of all scrap downstream (to the right in the block diagram above), not including the current process. This value simply stores the scrap value for the next upstream process.
- **Final Yield = Output Volume / ( Input Volume + Downstream Num of Scrap Parts)**

The following are calculations affected by yield:

- **Labor Cost = (Labor Rate \* Labor Time) / Final Yield**
- **Direct Overhead Cost = ((Labor Cost \* Overhead Multiplier) + (Overhead Rate \* Cycle Time)) / Final Yield**
- **Expendable Tooling Cost Per Part = (Expendable Tooling formula) / Final Yield**
- **Additional Direct Costs = (Additional Direct Costs formula) / Final Yield**
- **Material Cost = (Rough Mass \* Stock Cost Per Kg) / Final Yield**

## Selecting a virtual production environment (VPE)

A Virtual Production Environment (VPE) represents a manufacturing facility. aPriori provides a set of Starting Point VPEs representing average costs of manufacturing in various geographic regions. The elements that make up Starting Point VPEs, aPriori Manufacturing Cost Models and aPriori Regional Data Libraries, are separately licensed. Additionally, you may configure a VPE to represent your in-house manufacturing environment and cost structure or a supplier's manufacturing environment and cost structure.

By default, aPriori selects VPEs automatically (depending on how your installation is configured). For certain process steps you can display the current VPE details and manually select a different VPE (to determine the cost of performing them at a different facility with different manufacturing capabilities and cost structures). If the VPE commands are not available for a process step, they are disabled on the menu.

### To display VPE details

- 1 In the Manufacturing Process pane select **Edit > Show VPE Details** or right-click on the process step and select **Show VPE Details**. The VPE Details window appears, containing information and usage notes about the VPE, its groups and processes, and a log/description of changes made to the VPE over time.
- 2 To select a different VPE, click **Edit**.  
To close the VPE Details, click **Close**.

### To select a VPE

- 1 In the Manufacturing Process pane select **Edit > VPE Selection** or right-click on a process step and select **VPE Selection**. The VPE Selection window displays. (You can also select a VPE from the **Basic Options** section of the **Cost Guide**, as described in *Initial costing: the Cost Guide* on page 21.)
- 2 Click the **User Select** button.
- 3 Select a VPE from the list.
- 4 Click **Ok** to apply changes, recalculate the **Fully Burdened Cost**, and close the VPE Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the VPE Selection window.

A status indicator shows the costing status of the input:

- Green — Costing completed with the requested input.
- Yellow — Costing completed with warnings. Typically, indicates that the requested input was invalid and a different input, based on selection policy, was used for costing.
- Red — Costing failed.

You can see the warnings in the Status Messages pane.

## Selecting a machine for an operation

When you select a routing, aPriori automatically selects a machine for each process, based on machine feasibility and selection rules defined for each process. For example, for most processes, the machine must be physically large enough to accommodate the part. Of the machines that meet the feasibility rules, the machine that is selected typically is the machine of that set with the lowest overhead rate. You may manually select a different machine than the one that aPriori selects automatically.

The machines available for a process are defined by the selected VPE.

### To view the machines that can be used by a process

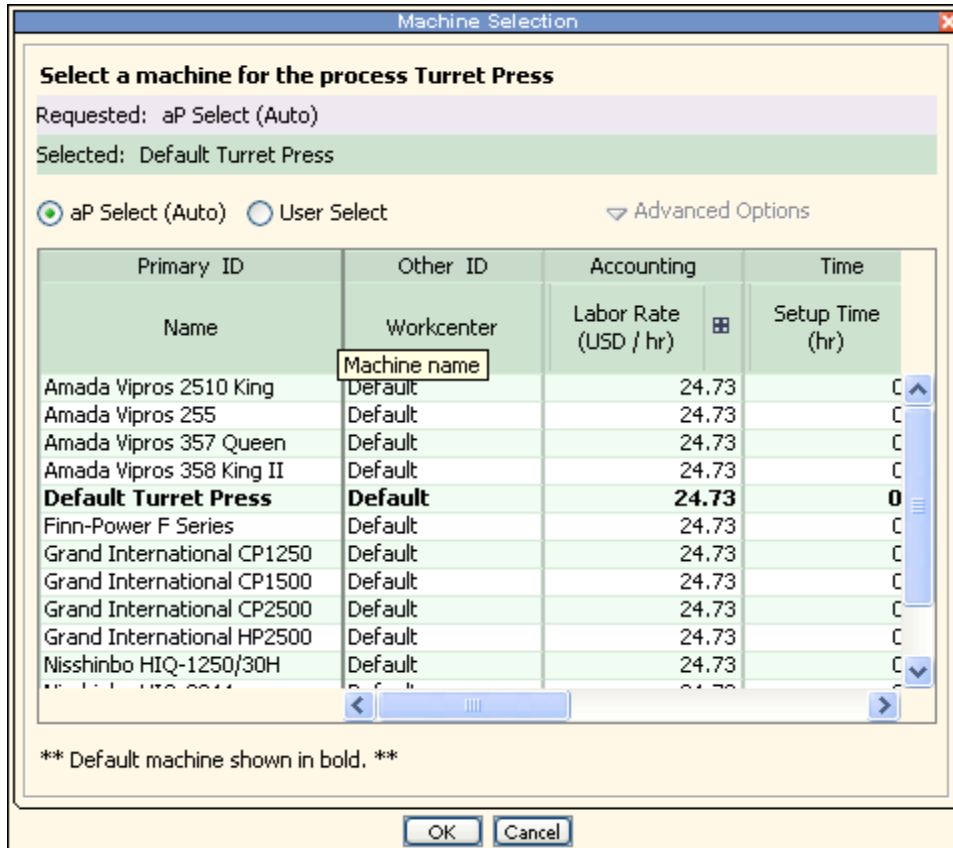
Do one of the following to display the machine properties for a process' machines on the **Machine Selection** window:

- If the process is included in the current routing, right-click the process in the **Manufacturing Process** pane and select **Machine Selection** from the context menu.
- If the process is not included in the current routing, select **Edit > Routing Selection** in the **Manufacturing Process** pane to display the **Routing Selection** window, then right-click the process and select **Machine Selection** from the context menu.

If the **Machine Selection** option is disabled on the context menu, machine selection is not allowed for the process.

**To manually select a machine for a process**

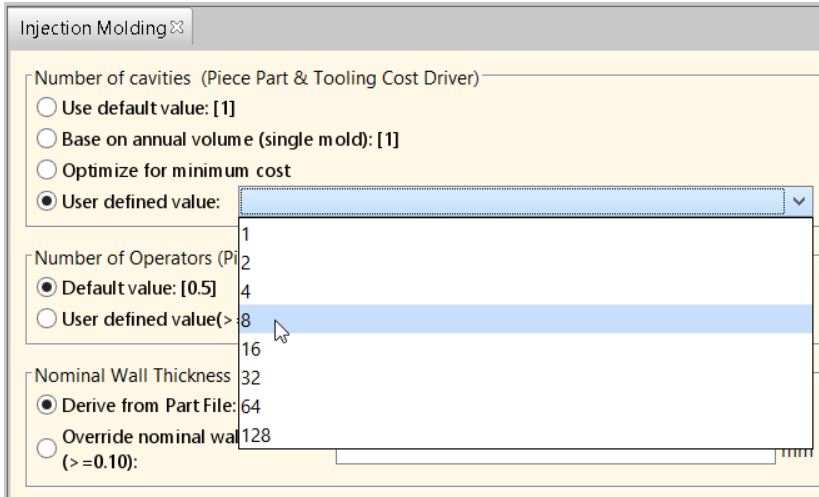
- 1 View the machines that can be used for a process on the **Machine Selection** window (see above).



- 2 Select a machine from the list.  
If you cannot select a machine, machine selection is not allowed for the process.
- 3 To change selection policy, click **Advanced Options**. You can choose from the following options:
  - Check feasibility; if not feasible, auto select.
  - Check feasibility; if not feasible, fail to cost.
  - Do not check feasibility.
- 4 Click **Ok** to apply changes, recalculate the cost, and close the Edit Machine Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the window.

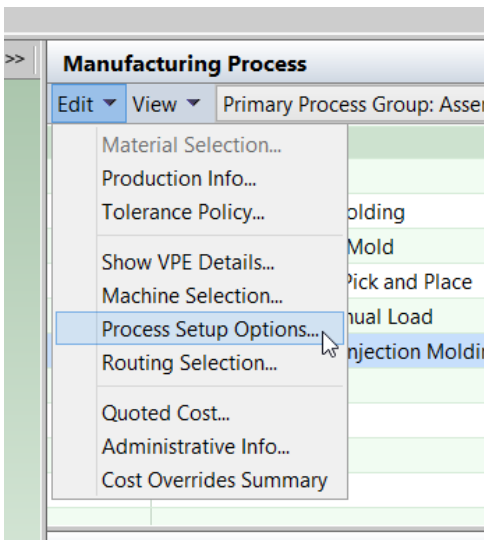
# Editing process setup options

Process setup options (also referred to as a *PSOs* or *setup options*) allow you to configure the costing of an individual part. For example, if you cost a part using the Plastic Molding process group, you can use a setup option to specify the number of mold cavities that should be assumed for that part.

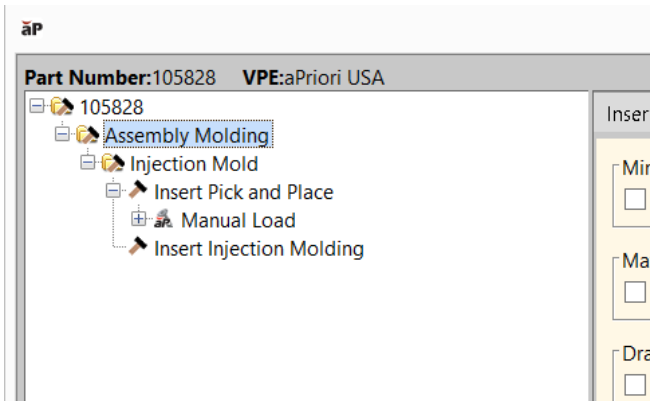


All PSOs have reasonable default settings (except for some process setup options in user-guided process groups--see the chapter User Guided Process Groups in the *Cost Model Guide*). You only need to use a setup option when you want to override the default.

You set PSOs with the Process Options Editor: select **Process Setup Options** from the Edit menu in the Manufacturing Process pane.

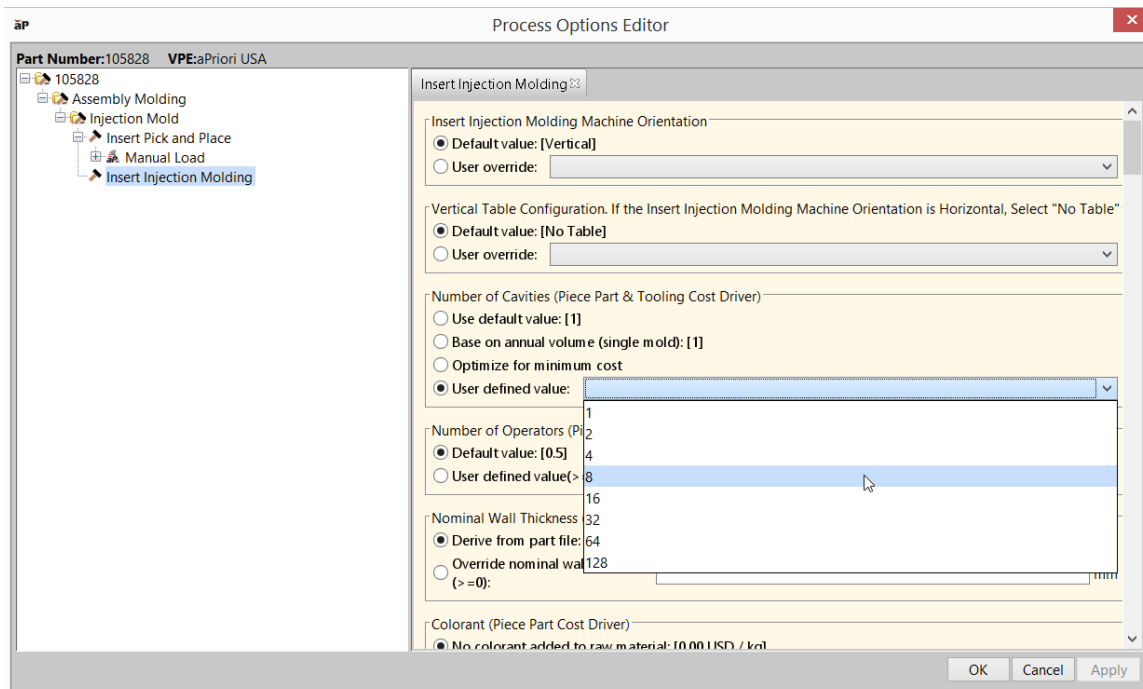


The left pane of the Process Options Editor displays the current routing as a tree, just as the Manufacturing Process pane does.

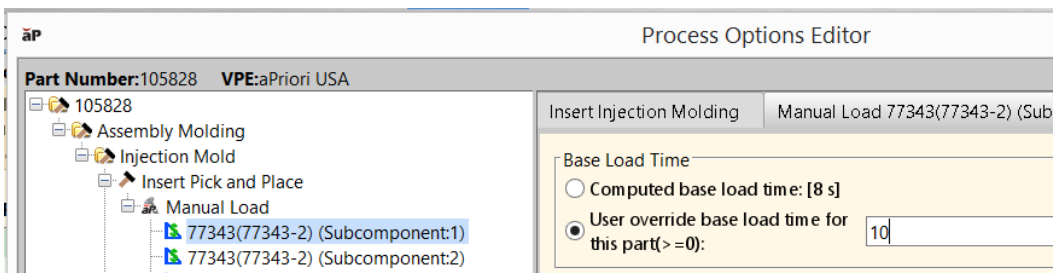


Each process setup option applies either at the process level or at the individual GCD level. A process-level setup option (such as **Number of Cavities**, mentioned above) has a single setting for a given part, while a GCD-level setup option can be set differently for different operations on different GCDs. For example, you can use a setup option to specify the load time for a particular insert in an Assembly Molding part.

To set a process-level option, click the relevant process in the navigation pane of the Process Options Editor:

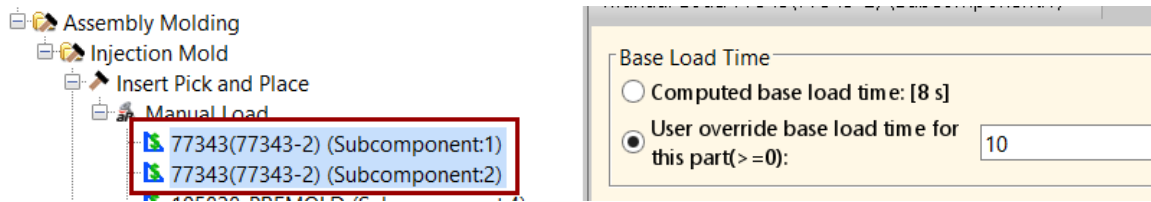


To set a GCD-level option, click the relevant GCD under the relevant operation occurrence in the navigation pane of the Process Options Editor:



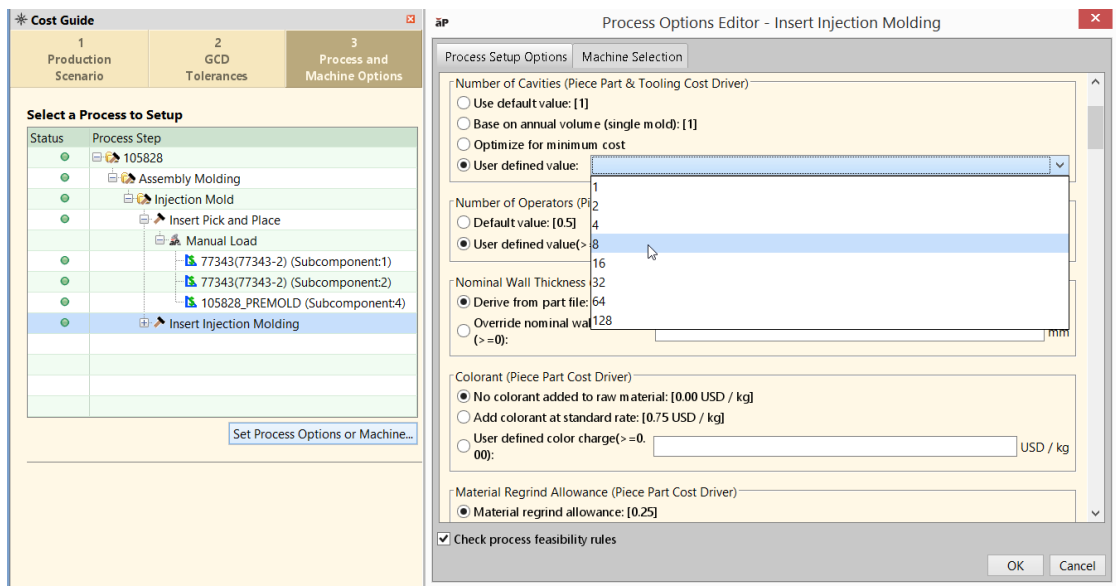


You can set a PSO on multiple GCDs at once: in the navigation pane of the Process Options Editor, click the first GCD and then either shift-click to select the end of a range of GCDs or ctrl-click to select additional GCDs:

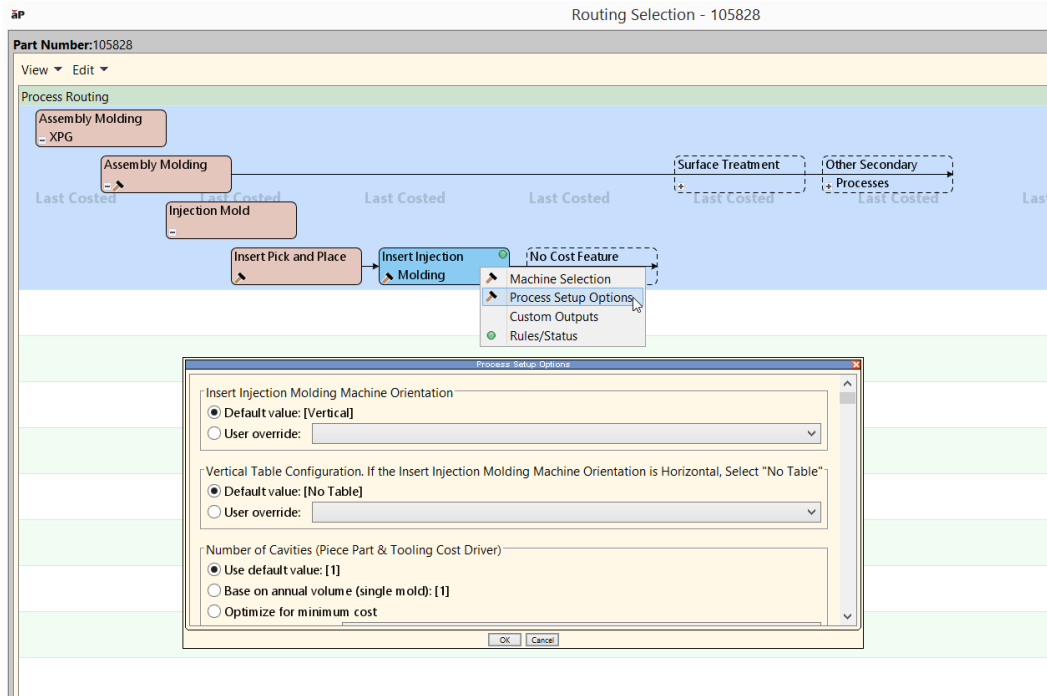


In addition to accessing PSOs from the Edit menu of the Manufacturing Process pane (described above), you can also access setup options from the following:

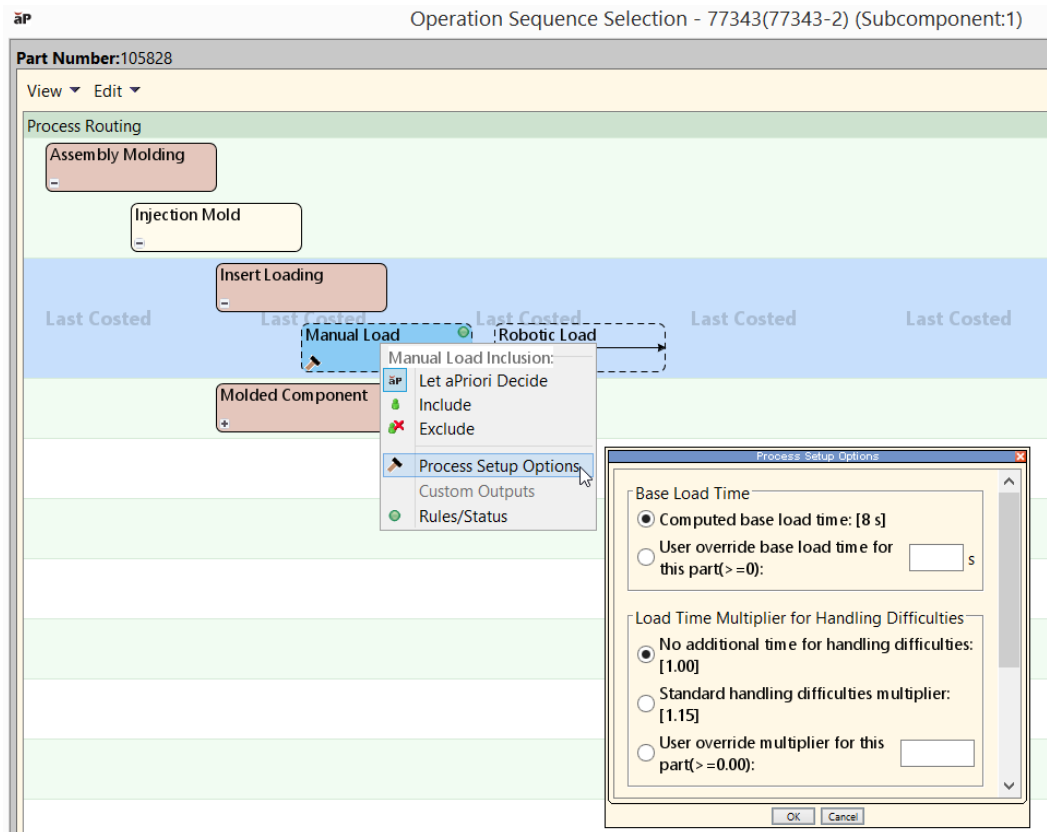
- Cost Guide:



- Routing Selection dialog:



- Operation Sequence Selection dialog:



**Note:** When you override a default with a PSO, aPriori validates your setting based on the information last extracted from the current part's CAD model. If you change the CAD model, the existing PSO setting is *not* re-validated. A value that is no longer valid can cause the part or some GCDs to fail to cost.

For details about the process setup options available for each process group, see the *Cost Model Guide*.

# Selecting a process routing

A process routing is a sequence of processes that completes manufacturing of a component (part or assembly); for example, Cut-to-Length > Laser Cut > Bend Brake. Since alternative and optional processes may be used to manufacture a component, multiple routing options exist for the same component. aPriori evaluates feasibility and cost of available routing options and auto-selects the best routing for the component. You can use the aPriori Routing Selection window to select an alternative routing manually and/or change routing options.

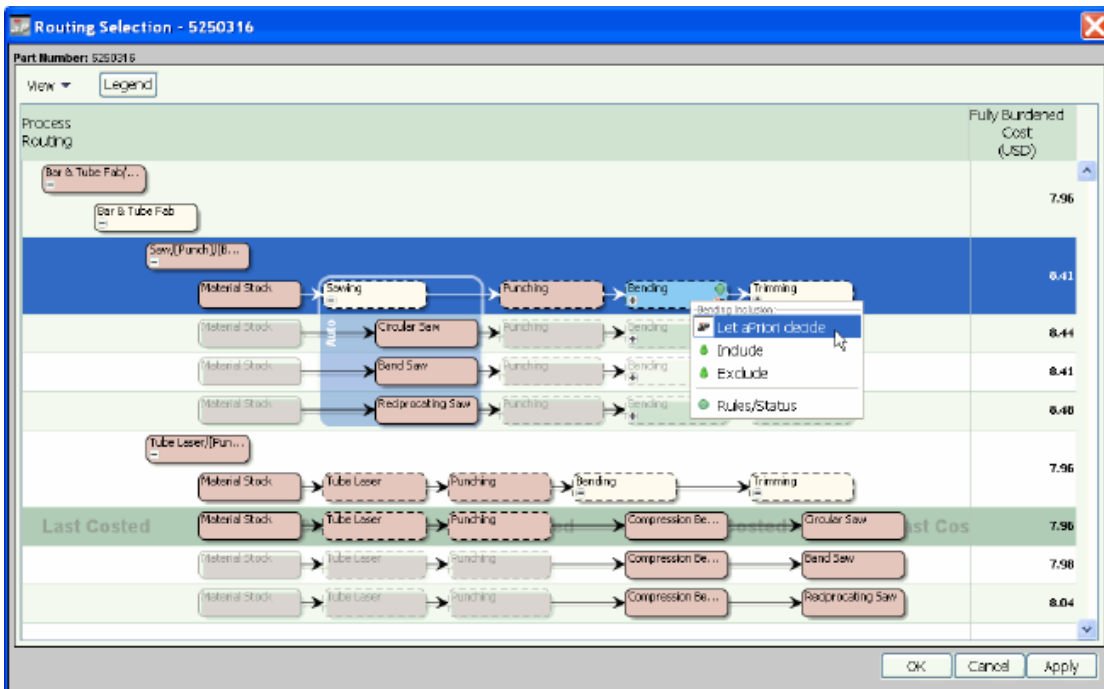
For details about the process setup options available for a specific process group, refer to the *Routings* section within the process group chapters.

## To display the Routing Selection window

In the **Manufacturing Process** pane, select **Edit > Routing Selection** or right-click and select **Routing Selection**.

The Routing Selection window displays:

- Alternative routings for the selected process.
- Optional processes for every routing.



The **Process Routing** column of the routing table shows all routing choices for the process. Every row in the routing table represents a routing choice.

The **Cost** column shows the cost of every routing. The last costed routing is highlighted and marked **Last Costed**.

See the tables below for an explanation of the symbols and conventions used in this display.

## Viewing options

The **View** menu gives you two options – **Show Routings with Incomplete Cost** and **Show Uncosted Processes within Visible Routings**. Using these options, you can create different views of the Routing Selection window:

If both options are unchecked, only the routings that have been costed without warnings are displayed.

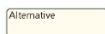
If the **Show Routings with Incomplete Cost** option is checked, routings that costed with warnings and available routings that were not costed are displayed in addition to the routings that were costed without warnings.

If the **Show Uncosted Processes within Visible Routings** option is checked, all uncosted nodes within the routing are displayed. A node could be uncosted if the process it is representing is not required for manufacturing the component or has been manually excluded from the routing.

## Understanding the legend

### Nodes

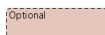
Click the **Legend** button to display the explanatory list of node types.



A beige background indicates that this node represents a choice between two or more alternative processes. Selecting a row that contains this type of node causes the system to auto-select between the underlying alternative processes.



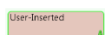
A solid border indicates that this node is marked as required. A feasibility rule failure at one of these nodes will cause an entire routing alternative to fail.



A dashed border indicates that this node is marked as optional. It may be included or excluded via a right-click menu.



A clear background indicates that this node was not evaluated by the system in the last costing event. This is either because of a feasibility rule failure, because the node has been excluded from the routing by a user, or because the node was not required for the manufacturing of the component.



A green border and user-override symbol indicate that the routing was customized, and this node was added. It may be removed from the routing via a right-click menu.

### Node status icons



The node succeeded (i.e., it passed feasibility evaluation).



A yellow status icon on a node indicates that the node passed feasibility evaluation but has some uncosted GCDs. Click on the icon to see which GCDs failed to cost.

A yellow status icon over a GCD icon in the **Cost** column indicates that this routing, although costed, has some uncosted GCDs associated with it. Hover the cursor over the icon to see what GCDs failed to cost.



A red status icon indicates that the node failed to cost. Click on the indicator to see why the process failed feasibility evaluation.




This node has Process Setup Options (PSOs) that can be customized by the user. Click the hammer or right-click the node and select **Process Setup Options**.



User override: .The routing has been customized.

## Expandable nodes

Nodes with a plus sign (  ) are expandable. When you click on the plus sign, the next level of detail is displayed. The node can expand vertically or horizontally:

- Alternative nodes expand vertically displaying two or more new lines underneath the node. Each line represents an alternative routing available for the node. You can select only one routing.
- Conjunctive nodes expand horizontally, displaying all available options in one line underneath the node. You can manually include one or more options into the routing.

## Selecting and editing a routing

Clicking a row in the Routing table selects the routing this row represents. Clicking a node selects the node and the row.

Selected node shows the cost status indicator:

- Green — Costing on this node completed successfully.
- Yellow — Costing on this node completed with warnings. Typically, indicates that feasibility rules were not evaluated or that there are uncosted GCDs associated with the process.
- Red — Costing on this node failed. Click on the red status indicator to see which GCDs failed to cost.

### To select and edit a routing

- 1 In the Manufacturing Process pane Select **Edit > Routing Selection** or right-click and select **Routing Selection**. The Routing Selection window is displayed.
- 2 Select a routing.
- 3 Change routing options as needed by *Selecting alternative processes on page 185* and *Using the right-click menu on page 187*.
- 4 You can even customize the routing for the component by inserting or reordering processes. This includes creating and inserting Custom Processes. For more information, see *Creating custom processes and routings on page 190*.

- 5 Click **Ok** to apply changes, recalculate the cost, and close the Routing Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the Routing Selection window.

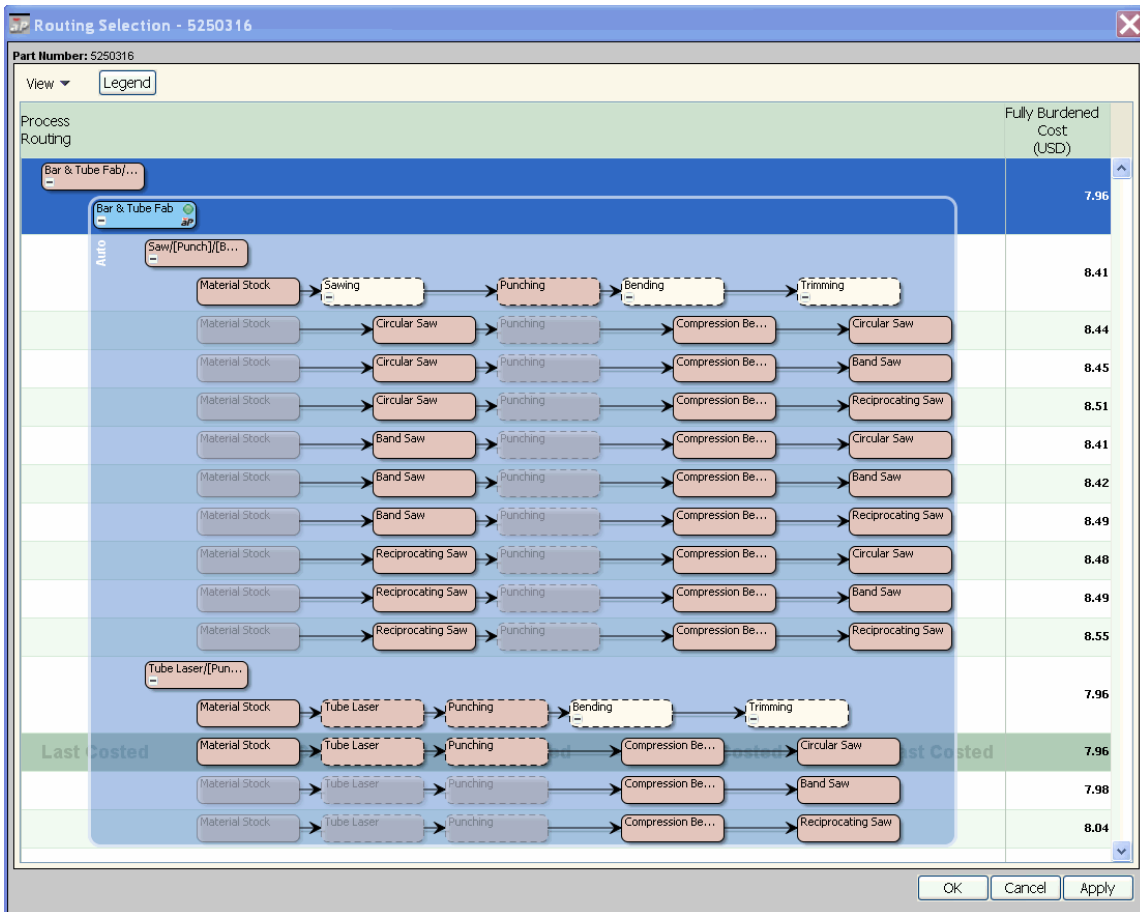
Once you selected a routing and closed the Routing Selection window, aPriori remembers the costs calculated in the last costing event only. This is sometimes called a *pinned routing* – this allows you to manually select a preferred routing so that aPriori does not spend time calculating several alternative routings when costing. When you open the Routing Selection window again, only the routings that were costed in the last costing event have values in the **Cost** column. The uncosted routings are displayed only if the **View > Show Routings with Incomplete Cost** option is selected.

## Selecting alternative processes

Alternative node is an expandable node representing a choice between two or more alternative processes. Each alternative process represents a separate routing. aPriori automatically selects a routing for costing, but you can manually select a different alternative. Only one routing can be selected.

When you expand an alternative node:

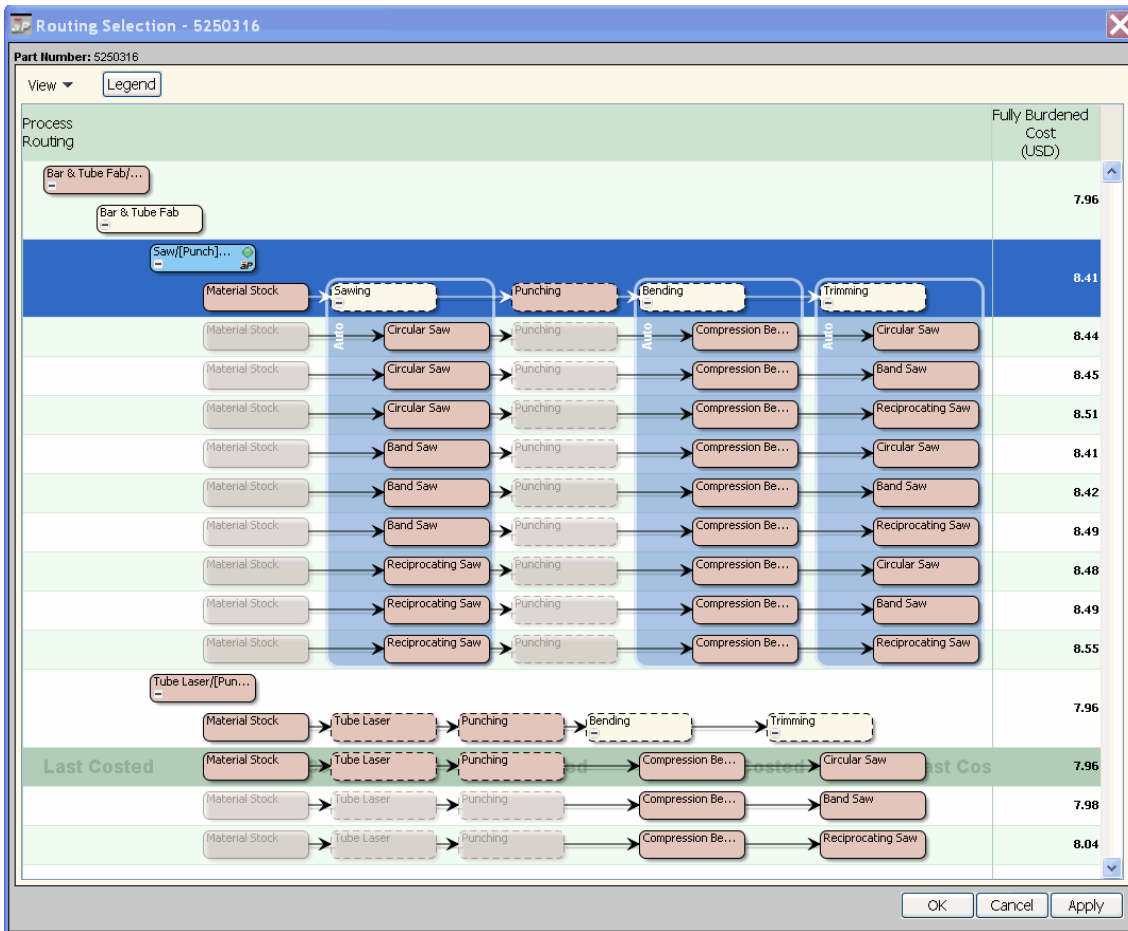
- Alternative routings for this node are displayed based on the selection in the **View** menu.
- The node and the entire scope of aPriori auto-select options is highlighted and surrounded by the **Auto** border.



If you click **OK** or **Apply** at this point, aPriori will automatically select a routing within the **Auto** border. You can also select a routing manually.

- If you manually select one routing under the alternative node, the scope of aPriori auto-select options changes and becomes limited to alternatives within that routing.





You can again click **OK** or **Apply** to let aPriori make a selection within the **Auto** border or make the selection manually.

## Reverting to aPriori auto-selected routing

### To revert to the routing automatically selected by aPriori

In the Routing Editor, select the highest-level node in the routing tree. This is the node specifying the Primary Process Group.

Click **OK** or **Apply**.

## Using the right-click menu

Right-clicking a node selects the node and the row and opens a menu with the following options:

- **Inclusion menu** – this option is only available for the nodes that can be manually included into and excluded from the routing:

**Let aPriori decide** – initially this option is selected, since by default aPriori decides whether to include or exclude the node.

**Include** – Select this option to manually include the selected node in the routing. The green icon on the node indicates that the node was manually included. Select **Let aPriori decide** to revert to the aPriori choice.

**Exclude** – Select this option to manually exclude the selected node from the routing. The node becomes crossed out and the green icon on the node indicates that the node was manually excluded. Select **Let aPriori decide** to revert to the aPriori choice.

- **Machine Selection** – this option allows the selection of a machine for the selected process. This has the same effect as selecting a machine from the Manufacturing Process tree.
- **Process Setup**– this option allows the selection of Process Setup options for the selected process. This has the same effect as selecting Process Setup from the Manufacturing Process tree.
- **Rules/Status** – this option displays the evaluation feasibility status for the node. For nodes representing alternative and optional processes it also displays the **User Selection Policy Options** window. In this window you can:

Select whether or not to check feasibility rules. For any node you can check the **Process** check box to evaluate the process feasibility rules.

Processes that have no more underlying processes associated with them must be assigned a machine. aPriori assigns a machine automatically. If you override aPriori choice and select the machine manually, a **Machine** check box becomes available in the **User Selection Policy Options** window, so you can check the machine feasibility rules.

Choose what to do if a rule fails – **Fail to cost** or **Revert to auto-select**.

## Selecting an unfeasible machine for a process

In some situations, aPriori considers a process to be unfeasible for auto-selected routing because there is no feasible machine for the process.

### To select an unfeasible machine for a process

- 1 In the Routing Editor, select **View > Show Uncosted Nodes within Visible Routings**. The unfeasible nodes are displayed with a red status sign. To see the message indicating why the process is not feasible, right-click on the process and select **Rules/Status**.
- 2 Select an unfeasible process and click **OK**. In the Manufacturing Process tree, the newly added process appears with a red status sign.
- 3 Right-click the newly added process and select **Machine Selection**.
- 4 Select the desired machine and click **Advance Options**.
- 5 Check the **Do not check feasibility** option. aPriori costs the component with manually selected process and machine while ignoring the feasibility rules for that process/machine.
- 6 Click **OK**.

## Using the auto-select parent process command

The Auto Select Parent Process command is available only for punched holes in Bar & Tube Primary Process Group. You can use this command to revert to the aPriori selected punching process from a manually selected punching process.

The following sequence of steps illustrates how you can use the Auto Select Parent Process command:

- 1 Open a Bar & Tube part with punched holes. You will see holes listed under Punching\SimpleHoles or Punching\ComplexHoles in the Routing Tree.
- 2 Select **Edit > Routing Selection** to open the Routing Selection window, see *Selecting a process routing* on page 182.
- 3 Select **All Processes** from the **View** menu.
- 4 Expand the Routing Tree until you see an uncosted Punching process.
- 5 Right-click the uncosted Punching process and select **Include** from the Inclusion menu.
- 6 Click **OK**. The Routing Selection window closes, and you can see two punching processes in the Routing Tree in the Manufacturing Process pane – **Punching** and **Punching 2**.
- 7 Select one or more holes under **Punching** and drag them to **Punching 2**. The Cost Output information becomes stale.
- 8 Click the **Cost** button. The Cost Outputs information is updated, and you can see the holes that you dragged under the **Punching 2** process.
- 9 Right-click a hole under **Punching 2**. The Auto Select Parent Process command is now available. Select this command to revert the hole to aPriori selected parent process. The Cost Outputs information becomes stale.
- 10 Click **Cost**. The cost outputs are updated, and you can see the hole back under the **Punching** process.

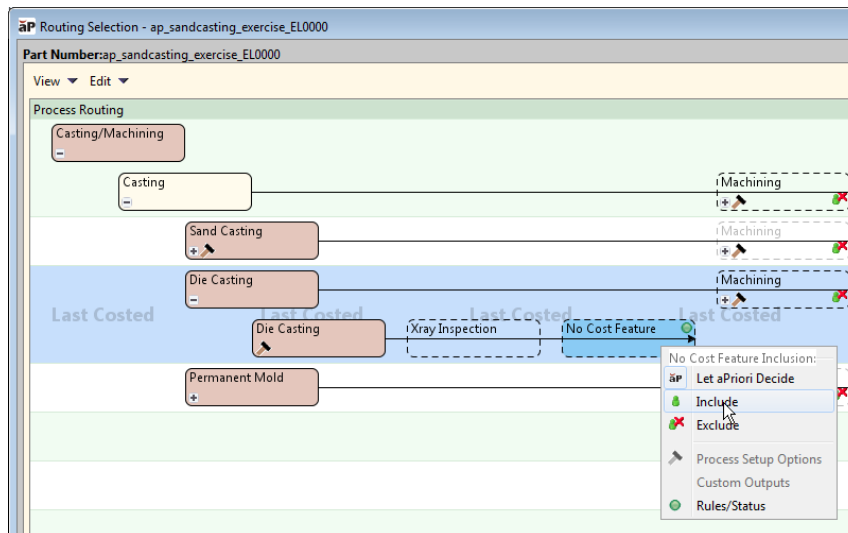
## No Cost Feature

aPriori provides a "No Cost Feature" operation for handling GCDs that should not contribute to the cost of a component. For example, if an operation on one GCD also happens to apply to an adjacent GCD, applying "No Cost Feature" to that adjacent GCD prevents double costing. aPriori automatically applies "No Cost Feature" when possible, but you can also apply this manually as needed.

An initial version of this functionality was introduced for machining in aPriori Release 2014 R1, but as of 2015 R1, this option is available across all process groups.

### To apply a No Cost Feature in the Routing Selection editor

In the **Routing Selection** editor, right-click the optional **No Cost Feature** operation and select **Include**. A sandcasting part is shown in the following example.



### To apply a No Cost Feature to a GCD

To apply No Cost Feature to a specific GCD, see *GCD operation sequence selection* on page 202.

## Creating custom processes and routings

You can create a custom routing for a part or assembly by inserting additional processes (including simple user-defined custom processes), reordering processes, and excluding processes. You may also customize an operation sequence performed to a specific GCD. This allows you to provide a routing variation and capture complete costs in situations where the pre-defined routings do not completely represent the actual manufacturing production processes performed on that component. Common situations where this may be useful include routings which use multiple instances of a single process (e.g., a part that is initially cut on one waterjet machine and later undergoes another cutting operation on a second waterjet machine), or routings which include simple secondary processes such as Inspections that are performed at various points throughout the routing. It is also very common to manually add surface treatments at the end of a routing.

Note that some processes cannot be manually added, such as milling or turning, progressive die, etc. Any processes that can be manually added are listed in the column displayed for Customize Routing.

**Note** aPriori Services can also extend your VPEs to extend the set of processes and pre-defined routings that are always available).

## Creating a custom routing

### To create or edit a custom routing

- 1 In the Manufacturing Process panel, click on the Edit menu and select Routing Selection... The Routing Selection editor window will appear.
- 2 Select Customize Routing... from the Edit menu. A panel will appear on the left side of the Routing Selection window, which lists processes available to insert into the routing. Processes are grouped by process group.
- 3 If necessary, create one or more custom processes to use in your routing. See [Creating a custom process on page 193](#).
- 4 For each process you are interested in adding to your routing, click on the process in the list of available processes, hold down the left mouse key, and drag the process from the panel onto the routing. As you do so, the User Interface will dynamically display arrows indicating where the process will be inserted if you release the mouse button. Drag the process to the desired position and release the left mouse key.  
  
If you wish to insert the process in a different location, you can simply drag-and-drop it to the new location.  
  
To remove the process from the routing, right-click on the node and select Remove from the popup menu.
- 5 If you wish to exclude any processes that are already in the routing, you can right-click on the node and select Exclude from the popup menu.
- 6 Depending on how you have customized your routing, it also may be necessary to customize the operation sequence for one or more GCDs. For more information, see [Creating a custom operation sequence on page 191](#).
- 7 Depending on how you have customized your routing, you also may need to manually assign operations on specific GCDs to different processes. See [Assigning operations to different processes on page 195](#) for more information.

## Creating a custom operation sequence

If you have customized a process routing, it also may be necessary to customize the operation sequence for one or more GCDs. This is because the order of operations in a GCDs operation sequence must be consistent with (i.e., must not conflict with) the order of processes in the component routing. We will illustrate this using an example from the aPriori starting point VPE routings.

For example, a sheet metal part may be costed with the process routing 'Laser Cut' '3 Axis Mill' 'Internal Grinder'

A SimpleHole GCD is assigned the operation sequence 'Laser Cutting' 'Reaming'. By default, there is no 'Internal Grinder' operations in that sequence, so you will need to customize the operation sequence if you wish both reaming and grinding operations to be applied to SimpleHoles.

You can customize the operation sequence by inserting the 'ID Finish Plunge Grinding' operation after the 'Reaming' operation, so that the custom operation sequence becomes:

'Laser Cutting' 'Reaming' 'ID Finish Plunge Grinding'

This is a valid customization, because the order of the operations is consistent with the order of the processes in the process routing.

However, if you customize the operation sequence by inserting the 'ID Finish Plunge Grinding' operation before the 'Reaming' operation:

'Laser Cutting' 'ID Finish Plunge Grinding' 'Reaming'

then the order of operations for the SimpleHole GCD will conflict with the order of processes in the parent routing. This is an invalid state. If you cost the part at this time, you will get an error message in the message tree.

To correct the order consistency problem, you must either:

- Leave the 'Internal Grinder' process after the 3 Axis Mill and insert the 'ID Finish Plunge Grinding' operation after the Reaming process
- Customize both the process routing and the operation sequence so that the Internal Grinder process comes prior to the 3-Axis Mill process and so the ID Finish Plunge Grinding operation comes before the Reaming process. Note that although this addresses the consistency issue, it does not make much sense from a manufacturing perspective.

### To create or edit a custom operation sequence

- 1 In the Geometric Cost Drivers panel, right click on the GCD(s) of interest and select Edit... from the popup menu. The Operation Sequence Selection editor window will appear.
- 2 Select Customize Routing... from the Edit menu. A panel will appear on the left side of the Operation Sequence Selection window, which lists operations available to insert into the sequence (grouped by their parent processes).
- 3 For each operation you are interested in adding to the operation sequence, click on the operation in the list of available operation, hold down the left mouse key, and drag the operation from the panel onto the routing. As you do so, the User Interface will dynamically display arrows indicating where the operation will be inserted if you release the mouse button. Drag the operation to the desired position and release the left mouse key.

If you wish to insert the operation in a different location, you can simply drag-and-drop it to the new location.

To remove the operation from the sequence, right-click on the node and select Remove from the popup menu.

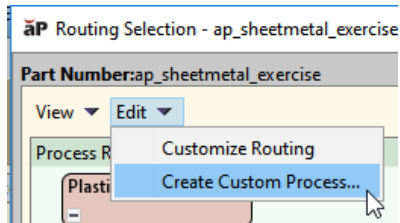
- 4 Depending on how you have customized your sequence, it also may be necessary to customize the parent process routing so that the order of processes is consistent with the order of operations.

## Creating a custom process

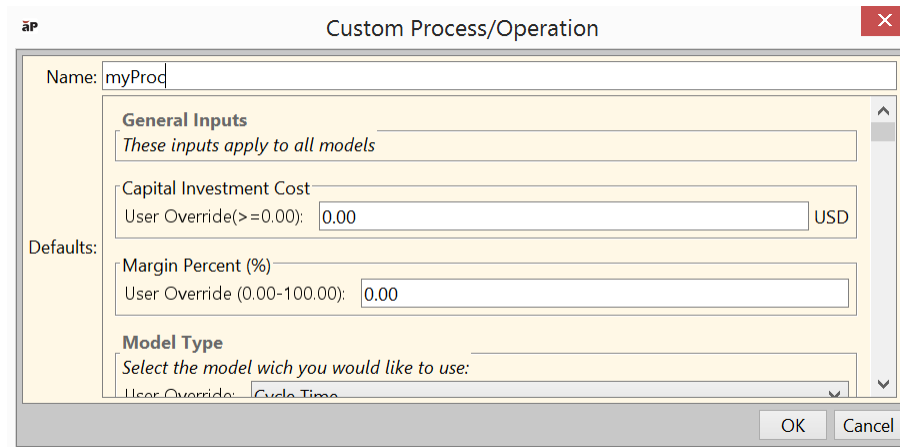
Custom processes provide a way to represent and account for extra processing that isn't included in a VPE's predefined routings. You can create a custom process, supply inputs via process setup options, and drag the custom process into a routing.

To create a custom process:

- 1 In the Manufacturing Process pane, Select **Routing Selection...** from the Edit menu. The Routing Selection editor appears.
- 2 In the Routing Selection editor, select **Create Custom Process...** from the Edit menu.



The Custom Process/Operation window appears.



- 3 In the Name field, enter a name for your custom process.
- 4 Enter General Inputs:
  - **Capital Investment Cost**
  - **Margin Percent**
- 5 Choose a **Model Type** (see below).
- 6 Enter the remaining inputs that are relevant to the Model Type you chose.

There are two general categories of model type:

- Cycle-time-based model types:
  - Cycle Time
  - Cycle Time Per Length
  - Cycle Time Per Each

- Cost-based model types:
  - Cost Per Surface Area
  - Cost Per Mass
  - Cost Per Length
  - Cost Per Each

For all cycle-time-based models, you enter the following:

- **Labor Time** (if you want to override labor time as calculated from cycle time—see below)
- **Number of operators**
- **Batch setup time**
- **Labor rate**
- Overhead information (either overhead rates or machine and workcenter information for bottom-up overhead-rate calculation)

You also enter the following model-type-specific information:

- Cycle Time model:
  - **Cycle Time**: enter the total cycle time required for a part.
- Cycle Time Per Length model:
  - **Cycle Time Per Length**: enter a time per unit length.
  - **Length**: enter the length that should drive cycle time, or else specify that it should be driven by the part length.
- Cycle Time Per Each model:
  - **Cycle Time Per Occurrence**: enter the cycle time per feature, for some cost-driving feature of parts, or enter the cycle time per item or operation for some item or operation associated with part manufacture.
  - **Number of Occurrences**: enter the number of occurrences of the feature, item, or operation for a single part.

For cost-based models, you enter the following model-type-specific information:

- Cost Per Surface Area model:
  - **Surface Area**: enter a surface area or specify that the model should use the part's surface area.
  - **Surface Area Affected**: enter the percentage of the specified surface area that should drive the cost of the part.
  - **Surface Area Rate**: enter a cost per unit area.
- Cost Per Mass model:
  - **Part Mass**: enter a mass or specify that the model should use the part's mass.
  - **Mass Affected**: enter the percentage of the specified mass that should drive the cost of the part.
  - **Mass Rate**: enter a cost per unit mass.
- Cost Per Length model:
  - **Length**: enter a length or specify that the model should use the part's length.



- **Length Affected:** enter the percentage of the specified length that should drive the cost of the part.
- **Length Rate:** enter a cost per unit length.
- **Cost Per Each model:**
  - **Cost Per Occurrence:** enter the cost per feature, for some cost-driving feature of parts, or enter the cycle time per item or operation for some item or operation associated with part manufacture.
  - **Number of Occurrences:** enter the number of occurrences of the feature, item, or operation for a single part.

Cycle-time-based models calculate overhead costs and rates as described in the *Cost Model Guide* chapter Direct and Indirect Overhead. They also use standard formulas for labor and batch setup costs per part:

**Labor Cost = (Cycle Time \* Number of Operators \* Labor Rate) / Final Yield**

**Amortized Batch Setup =  
(Batch Setup Time \* (Labor Rate + Direct Overhead Rate)) / Batch Size**

Labor Time Standard for the custom process is assumed to be 1. Labor handling time is assumed to be 0.

Yields are calculated as described for the current process group in the *Cost Model Guide*. Good Part Yield for the custom process is assumed to be 1.

Cost-based models categorize costs (excluding capital investment and margin) under Additional Direct Costs .

To include the custom process in a routing, simply drag it and drop it into the desired routing sequence. After it is included in the routing, you can modify the definition or inputs to the custom process by right-clicking the node in the routing editor and selecting **Process Setup Options**.

Note that custom processes created within one scenario are not available for reuse in other parts.

## Assigning operations to different processes

Depending on how you have customized your routing, you also may need to manually assign operations on specific GCDs to different processes.

For example, you may have added a second instance of a “2Axis Lathe” process, so that roughing of curved wall GCDs can occur on the first lathe and finishing of the curved wall GCDs can occur on the second lathe. By default, all operations are assigned to the first instance of a process, so you will need to manually assign the finishing operations to the second lathe process.

### To manually assign GCD operations to another process

- 1 In the Manufacturing Process pane, click on the + symbols to expand the process nodes of interest (in this example, you would see a node named “2 Axis Lathe” and another node named “2 Axis Lathe:2”).
- 2 Each process node will have sub-nodes representing the operations assigned to that process and the GCDs they are being performed on. (In this example, you would see

that the first “2 Axis Lathe” node contains a Rough Turning node and a Finish Turning node, each with Curved Wall GCDs under them. The second lathe process “2 Axis Lathe:2” would not initially have any operations or GCDs under it, as all operations are by default performed on the first lathe).

- 3 For each operation/GCD pair of interest, click on the GCD node and drag-and-drop it onto the new process node (In this example, you would click on a curved wall GCD located under the Finish Turning node and drag it from the “2 Axis Lathe” node onto the “2 Axis Lathe:2”). You can multi-select GCDs or GCD/Operation pairs to drag by holding down the Ctrl-key. If you are unable to drop the operation/GCD pair on the process node of interest, see Note: below.
- 4 The Manufacturing Process pane will update to reflect how GCDs/operations are now assigned. (In this example, you will now see a Finish Turning node under the “2 Axis Lathe:2” process, and a curved wall GCD under it indicating that curved wall is now being finished on the second lathe.) Continue dragging-and-dropping until all operations/GCDs are assigned to the appropriate lathe processes.

If you are unable to drop the operation/GCD pair on the process node of interest, you may also need to change or edit the Operation Sequence routing.

Building on the earlier example, if you customize the process routing to insert a new 3 Axis Lathe process (instead of the second 2 Axis Lathe) following the original 2 Axis Lathe process, you will not initially be able to drag curved wall operations to the 3 Axis Lathe. This happens because the currently-selected operation sequence for the curved wall does not contain 3 Axis Lathe operations. To fix this, open the Operation Sequence Selection window for the GCD(s) of interest and select an operation sequence that includes the 3 Axis Lathe. In other examples, you may need to customize the Operation Sequence to include the processes that were added to the part routing. For more information on customizing operation sequences, see [Creating a custom operation sequence on page 191](#).

## Highlighting associated GCDs

The Highlight Associated GCDs command allows you to select a manufacturing step from the Routing Tree and highlight the GCDs associated with this step in the Component Viewer and in the Geometric Cost Drivers table.

In Direct Integration mode, if the component is opened in the active window in the CAD system, the associated GCDs are highlighted in the CAD model.

### To highlight associated GCDs

Right-click a step in the manufacturing process and select **Highlight Associated GCDs**.

**Note:** You can also highlight GCDs of a particular type directly from the Component Viewer. (See the description of the **Marquee Selection Tool** in the *Component Viewer* on page 51.)

# Specifying simultaneous operations

With aPriori Manufacturing Cost Models, you can specify simultaneous operations for turned parts manufactured on a 4-axis or 6-axis lathe. Custom VPEs can be more broadly configured to contain operations assignment logic with includes support for automatic determination of simultaneous operations.

## To specify simultaneous operations

- 1 Select a routing that contains a 4-axis or 6-axis lathe process
- 2 In the Manufacturing Process pane, expand the tree to display the lathe process node and the operations and associated GCDs below that node. Under the lathe process node, you also will see a node called "Simultaneous Group".
- 3 You can drag-and-drop operations on specific GCDs into the "Simultaneous Group" node, to indicate they should be performed simultaneously:
  - First click on the GCD row; it will be highlighted in blue.
  - Next, click on the same GCD row and hold down the mouse key, drag it over to the Simultaneous Group node, and release the mouse key.
  - The operation and GCD nodes will be moved under the Simultaneous Group node.
  - Select a routing that contains a 4-axis or 6-axis lathe process

## To remove an operation from the simultaneous Group node

Use the same technique described in step 3 above to drag-and-drop the GCD back to the 4-axis or 6-axis lathe process node. The operation/GCD will be moved back to its original location and no longer appear under the Simultaneous Group node.

# 8 Geometric Cost Drivers

A Geometric Cost Driver (GCD) is a geometric attribute in the solid model of an MCAD component (part or assembly) that drives cost on the manufacturing floor. A GCD may be a physical concept, such as the thickness of sheet metal or the finished mass of a cast part; or it may be a geometrical concept, such as a bend, a hole, or a draft angle.

Each GCD can occur in multiple instances per component. In part manufacturing, GCDs are generally obtained through geometric analysis of the CAD model (for example, holes, straight bends, side cores, etc.). In assembly manufacturing, GCDs are often user defined (for example, ProWelds and virtual welds).

---

This chapter includes the following topics:

- Overview
  - Geometric cost drivers tree/table
  - GCD commands
  - GCD operation sequence selection
  - "Not Supported" GCD Messages
  - GCD categories
  - Component GCDs
  - Volume GCDs
  - Bending/forming GCDs
  - Holes GCDs
  - Surfaces GCDs
  - Weld GCDs
  - 2-Model GCDs
  - GCD relations
-

## Overview

A Geometric Cost Driver (GCD) is a geometric attribute in the solid model of an MCAD component (part or assembly) that drives cost on the manufacturing floor. A GCD may be a physical concept, such as the thickness of sheet metal or the finished mass of a cast part; or it may be a geometrical concept, such as a bend, a hole, or a draft angle.

Each GCD can occur in multiple instances per component. In part manufacturing, GCDs are generally obtained through geometric analysis of the CAD model (for example, holes, straight bends, side cores, etc.). In assembly manufacturing, GCDs are often user defined (for example, ProWelds and virtual welds).

The details and options available for GCDs vary between components and across process groups.

### Working with large parts

Large parts might contain thousands of GCDs in a single category (such as Curved Walls or Curved Surfaces). To avoid performance issues when working with this many GCDs, aPriori automatically highlights and selects GCDs only when the GCD Category node has fewer than 2000 GCDs. GCDs will not be highlighted if more than this number is selected. Note that your aPriori System Administrator can modify this setting with the `gcds.to.highlight.threshold` property in the `apriori.properties` or `apriori.user.properties` file. See the *System Administration Guide* for more details.

### Displaying GCDs

Use the following procedures to display some or all GCDs for a component.

#### To display all GCDs for a component

In the GCDs pane, select **Show > All**.

#### To display only relevant GCDs for a component

In the GCDs pane, select **Show > Relevant**. This is the default selection.

**Note** Curved Bend and Closed Bend GCDs in Sheet Metal are no longer used. They are supported for backward compatibility to existing models but are not shown by default in the GCD tree. To view these GCDs, use the **Show > All** option.

There are additional discussions regarding the display of GCDs at:

- Working with large parts above
- Component Viewer on page 51
- Highlighting associated GCDs on page 196

## Geometric cost drivers tree/table

The left side of the GCDs panel displays a tree of GCDs and GCD relations for the active component. You can drill down to the level of detail you want to view. The right side of the panel displays details about the highlighted GCD.





Geometric Cost Drivers				
Show ▾				
Status	Name	...	Name	Property Result
●	Component		Name	ComplexHole:1
●	Base Properties [1]		Area (mm^2)	2,118.62
●	Blank [1]		SEC Diameter (mm)	88.87
●	Main Surface [1]		Mec Diameter (mm)	25.40
●	Setup Axes/Candidates [16]		Perimeter (mm)	206.80
●	Bending/Forming		SER Length (mm)	88.86
●	Bends [3]		SER Width (mm)	25.40
●	StraightBend:1		Tolerance/Profile of Surface (mm)	0.00001
	CurvedWall:27		Roughness (µm)	0.00001
	CurvedWall:28		Length (mm)	9.53
	GCD Relations		Chamfer Direction	UNKNOWN
	StraightBend:2		Flange Direction	UNKNOWN
	StraightBend:3		Is Chamfered	false
●	Holes		Is Flanged	false
●	Simple Holes [8]		Has Straight Walls	true
●	Complex Holes [1]		Max Radius (mm)	12.70
●	ComplexHole:1		Min Radius (mm)	12.70
●	Surfaces		Number Of Coining Chains	-
●	Planar Faces [26]		Curved Length (mm)	79.80
●	Curved Walls [10]		Num Curved Edges	2
●	Curved Surfaces [6]		Num Edges	4
●	Other		Num Straight Edges	2
●	Edges [36]		Num Sharp Corners	-
	GCD Relations		Worst Peninsular Ratio	0.00
	Lies Near [32]		Worst Peninsular Ratio2	0.00
	Lies Outside [3]		Is Planar	true
	Intersects [15]		Accessibility	UNKNOWN
	Ends On [3]		Hole Direction Accessible	true
	Adjacent [32]		Hole Dir Obstruction Distance (mm)	-
	Is Orthogonal [6]		Sub Type	OBRound
	Is Accessible From [418]		User-Specified Setup Axis	
			Requested	< auto-select >
			Selected	Rough Milling
			Time (s)	38
			Status	●

On the highest level of the GCD tree, you have GCD types, such as **Component**, **Holes**, or **Surfaces**. Every part or assembly has Component type GCDs. Component GCDs provide the highest-level information for a part or an assembly, such as overall dimensions, volume, or cross section. GCDs included in the component type vary depending on the Manufacturing Process Group.

The rest of the GCD types correspond to types of features and to manufacturing approach, for example **Holes** or **Bending/Forming**. These types vary depending on the Manufacturing Process Group. Each GCD of such type corresponds to a specific manufacturing operation.


Each GCD presents iconic status and user input indicators. The status indicator provides a red/yellow/green icon to indicate an error/warning/success status. The user input indicator provides a green user icon to indicate that you have made an explicit GCD edit (e.g. operation or tolerance change).

The following icons are used in the GCD tree:

Icon	Usage
	A GCD Type. The number in brackets indicates the number of GCDs of that type for the selected component.
	An Individual GCD. GCDs can be primary or nested. A primary GCD serves as a primary input to costing or analysis. A nested GCD belongs to a higher GCD level. Nested GCDs have less information and fewer options than primary GCDs.
	A GCD Relation Type. The number in brackets indicates the number of GCDs of that type for the selected component.
	A GCD Relation.

Double-click a GCD Type or GCD Relation Type to see all GCDs/relations of that type in the GCD tree. Each row represents one GCD.

When you select an individual GCD:

- The GCD properties are displayed in the table on the right. Fields with the  icon are editable.
- The GCD is highlighted in the Component Viewer.
- Manufacturing process steps related to this GCD are highlighted in the Manufacturing Process pane.

When you select a GCD relation, the related GCDs are highlighted in the Component Viewer.

## Editing values in the GCD properties table

In the GCD Properties Table, fields with the  icon are editable.

### To edit a value

- 1 Double-click on the field.
- 2 Type a new value.
- 3 Press **Enter**.

## Costing a component after editing GCD properties

When in Auto-Costing mode, the component will be costed as soon as the GCD edit is made. When in One Click Costing mode, the component will not be costed until you explicitly click the **Cost** button. This allows you to make several GCD level edits and cost these changes in a single costing event.

## GCD commands

Select a GCD and right-click in the GCDs pane to see the GCDs command menu. Use the Shift and Ctrl keys to select multiple GCDs of the same type for bulk editing. Commands in the menu apply to the highlighted GCDs. Commands unavailable for the highlighted GCDs are disabled.

The GCDs command menu includes the following commands:

- **Edit:** Opens the Geometric Cost Driver Editor for the highlighted GCDs.
- **Remove:** Deletes the selected virtual weld.
- **Edit tolerances:** Opens the Tolerance Editor for the highlighted GCDs. If no GCD is highlighted, this command is unavailable.
- Alternatively, you can edit tolerance and roughness values directly in the GCD Properties table.
- **Auto-merge:** Auto-merges an unmerged ComboVoid GCD. Available only for ComboVoid GCDs that have been unmerged using the **Unmerge** command below.
- **Unmerge:** Unmerges a SimpleHole or a MultiStepHole GCD from a Void GCD in a ComboVoid GCD.

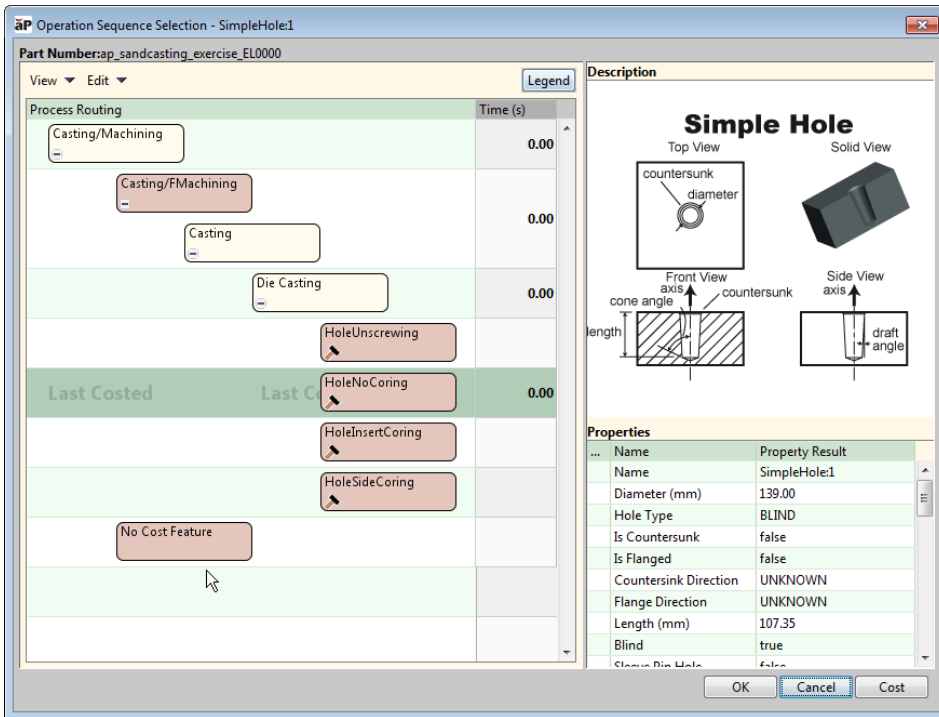
## GCD operation sequence selection

### To open the Operation Sequence Selection window

Double-click a GCD or highlight a GCD, right-click and select **Edit**. Use the **Shift** and **Ctrl** keys to highlight multiple GCDs of the same type.

**Note:** The Operation Sequence Selection window opens only if editing operation sequence is allowed for the selected GCD.



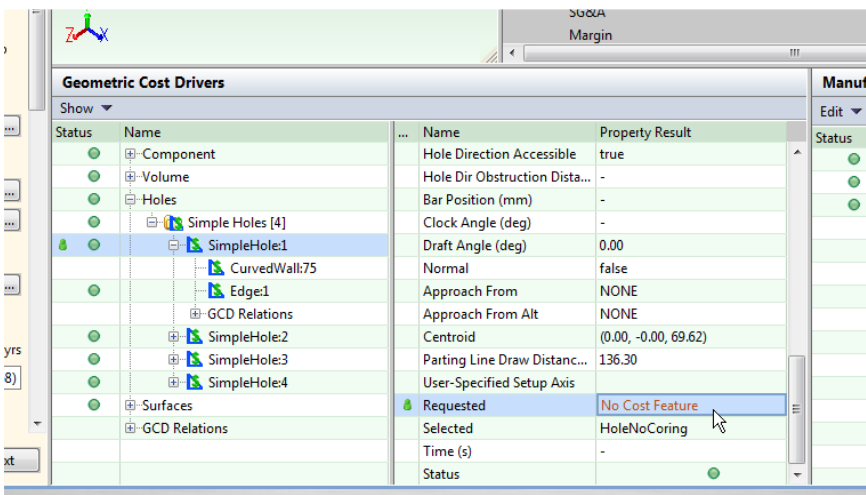


**To assign the No Cost Feature operation to a GCD**

The No Cost Feature operation allows you to specify that a GCD should not contribute to a part's cost. (See

*No Cost Feature* on page 189).

You assign this operation to a GCD in the **Operation Sequence Selection** window by selecting the **No Cost Feature** operation block and clicking **OK**. Once set, this override is displayed in the **Geometric Cost Drivers** pane. After successful costing, the **Selected** field will also reflect "No Cost Feature".



In general, applying "No Cost Feature" to a GCD with children will also apply to the children (there are some exceptions such as Edge, CurvedSurface, CurvedWall, and PlanarFace). If you apply "No Cost Feature" to a child GCD, the parent's **Selected** field will note "<child\_gcd>/No Cost Feature" after successful costing.

# "Not Supported" GCD Messages

If aPriori encounters a GCD that it does not support, it lists the problem GCD in the "Not Supported" list along with a brief cause, and also highlights the GCD (if possible) in the viewer.

**Geometric Cost Drivers**

Show ▾

Status	Name	GCD	
		Name	Cause
●	⊕ Component		
●	⊕ Volume		
●	⊕ Holes		
●	⊕ Surfaces		
	⊖ Not Supported		
	⊖  Not Supported [9]	Not Supporte...	DETACHED_SOLID
	Not Supported:1	Not Supporte...	DETACHED_SOLID
	Not Supported:2	Not Supporte...	DETACHED_SOLID
	Not Supported:3	Not Supporte...	DETACHED_SOLID
	Not Supported:4	Not Supporte...	DETACHED_SOLID
	Not Supported:5		
	Not Supported:6		
	Not Supported:7		
	Not Supported:8		
	Not Supported:9		
	⊕ GCD Relations		

Here is summary of the "Cause" messages and what they mean:

NON\_MANIFOLD\_EDGES: An edge is attached to 3 or more surfaces, indicating impossible solid geometry to manufacture.

SURFACE\_GEOMETRY: The model contains only surface geometry, no solid body.

**DIFFERENT\_THICKNESS:** Geometry has different thickness than the rest of the part, which is not supported in Sheet Metal.

**DISCONNECTED\_SURFACES:** The CAD file contains surfaces without edges likely due to a CAD modeling or translation error. This issue is not visible in the viewer.

**VOID\_GEOMETRY\_NON\_MANUFACTURABLE:** Void “bubble”: the void has no openings to the outside. Void bubbles cannot be manufactured in some Process Groups such as Casting or Machining. They can be manufactured in other Process Groups such as Rotational and Blow Molding, or Bar & Tube Fabrication.

**DETACHED\_SOLID:** Multiple bodies exist in the model. Only the largest body is used, and the remainder are ignored. This is a result of “free body” processing mode. (See *Costing multi-body parts* on page 295 for more information.)

**TESSELLATION\_VOID:** Tessellation/translation error: the tessellation (the 3D image displayed in the viewer) contains a void that does not exist in the BREP (the CAD model).

**TESSELLATION\_BUBBLE:** Similar to above, but there is an extra solid body formed by the tessellation that does not exist in the BREP.

**UNRECOGNIZED\_FEATURE:** aPriori cannot process the GCD. This can be due to many different reasons, differing by process group. For example, in Bar & Tube Fabrication, a feature might be considered “unrecognized” because it requires volumetric machining rather than the processes available in Bar & Tube. Or it might be unrecognized if the end of a tube is modeled as a solid bar instead of a tube.

**UNKNOWN:** The migrated part had GCDs extracted prior to aP 2014 R2. If you have access to the CAD file, please open it in aPriori and recost the component to reextract GCDs in the current version of aPriori.

## Operation sequence table

The Operation Sequence table for the selected GCD shows:

- The sequence of operations
- All alternative operations
- All optional operations
- The time to perform the selected sequence


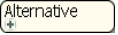
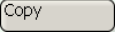

## Viewing options

The **View** menu gives you two options – **Show Routings with Incomplete Cost** and **Show Uncosted Processes within Visible Routings**. Using these options, you can create different views of the Operation Sequence Selection window:

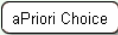
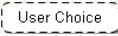
- If both options are unchecked, only the sequences that have been costed without warnings are displayed.
- If the **Show Routings with Incomplete Cost** option is checked, sequences that costed with warnings and also available sequences that were not costed are displayed.
- If the **Show Uncosted Processes within Visible Routings** option is checked, all uncosted nodes within the sequence are displayed. A node could be uncosted if the operation it is representing is not required for the GCD or has been manually excluded from the sequence.

## Understanding the legend

Click the **Legend** button to display the explanatory list of node types.

- |   |   |
|---|---|
|    | A node required by aPriori for the selected Manufacturing Process Group. A failure at one of the required nodes causes the entire routing to fail.  |
|    | An expandable node representing a choice between two or more alternative processes. Each alternative represents a routing.  |
|  | A copy of a node created as a result of expanding the original node. Copy nodes appear faded, but they are still costed in every routing.   |
|  | A node that was not costed by aPriori because it was not required for manufacturing the component or has been manually excluded from the routing. Uncosted nodes are displayed only when you select <b>Show Uncosted Nodes within Visible Routings</b> from the <b>View</b> menu. |

## Node Borders

- |   |  |
|---|--|
|  | Solid border indicates that the node is included by aPriori and cannot be included or excluded manually. |
|  | Dashed border indicates that the node can be included or excluded manually.                              |

## Expandable nodes

Nodes with the plus sign are expandable. When you click on the plus sign, the next level of detail is displayed. The node can expand vertically or horizontally:

- Alternative nodes expand vertically displaying two or more new lines underneath the node. Each line represents an alternative sequence available for the node. You can select only one sequence.
- Conjunctive nodes expand horizontally, displaying all available options in one line underneath the node. You can manually include one or more options into the operation sequence.

## Selecting and editing an operation sequence

Clicking a row in the Operation Sequence table selects the operation sequence this row represents. Clicking a node selects the node and the row.

Selected node shows the cost status indicator:

- Green — Costing on this node completed successfully.
- Yellow — Costing on this node completed with warnings. Typically, indicates that feasibility rules were not evaluated for the operation.
- Red — Costing on this node failed. Indicates that operation failed feasibility evaluation.

### To select and edit an operation sequence

- 1 In the Geometric Cost Drivers pane, highlight a GCD, right-click and select **Edit**. The Operation Sequence Selection window is displayed.
- 2 Select an operation sequence.
- 3 Change operation sequence options as needed by *Selecting alternative operations* (see page 207) and *Using the right-click menu* (see page 209).
- 4 Click **Ok** to apply changes, recalculate the cost, and close the Operation Sequence Selection window; or click **Apply** to apply changes and recalculate the cost without leaving the Operation Sequence Selection window.

**Note** Once you selected an operation sequence and closed the Operation Sequence Selection window, aPriori remembers the costs calculated in the last costing event only. When you open the Operation Sequence Selection window again, only the sequences that were costed in the last costing event have values in the **Time** column. The uncosted sequences are displayed only if the **View > Show Routings with Incomplete Cost** option is selected.

## Selecting alternative operations

Alternative node is an expandable node representing a choice between two or more alternative operations. Each alternative operation represents a separate sequence. aPriori automatically selects a sequence for costing, but you can manually select a different alternative. Only one sequence can be selected.

When you expand an alternative node:

- Alternative sequences for this node are displayed based on the selection in the **View** menu.
- The node and the entire scope of aPriori auto-select options is surrounded by the **Auto** border.

**Operation Sequence Selection - SimpleHole: 1**

Part Number: 5250316

View Legend

Operation Sequence		Time (s)
SimpleHole	ap	3.06
Auto	Bar & Tube Fab/...	3.06
	LaserOnly	
	PunchOnly	3.06
	LaserBore	
	PunchBore	
	Machining	
	Exact Drill	
	Drill and Bore	
	Circular Milling	

**Description**

**Simple Hole**

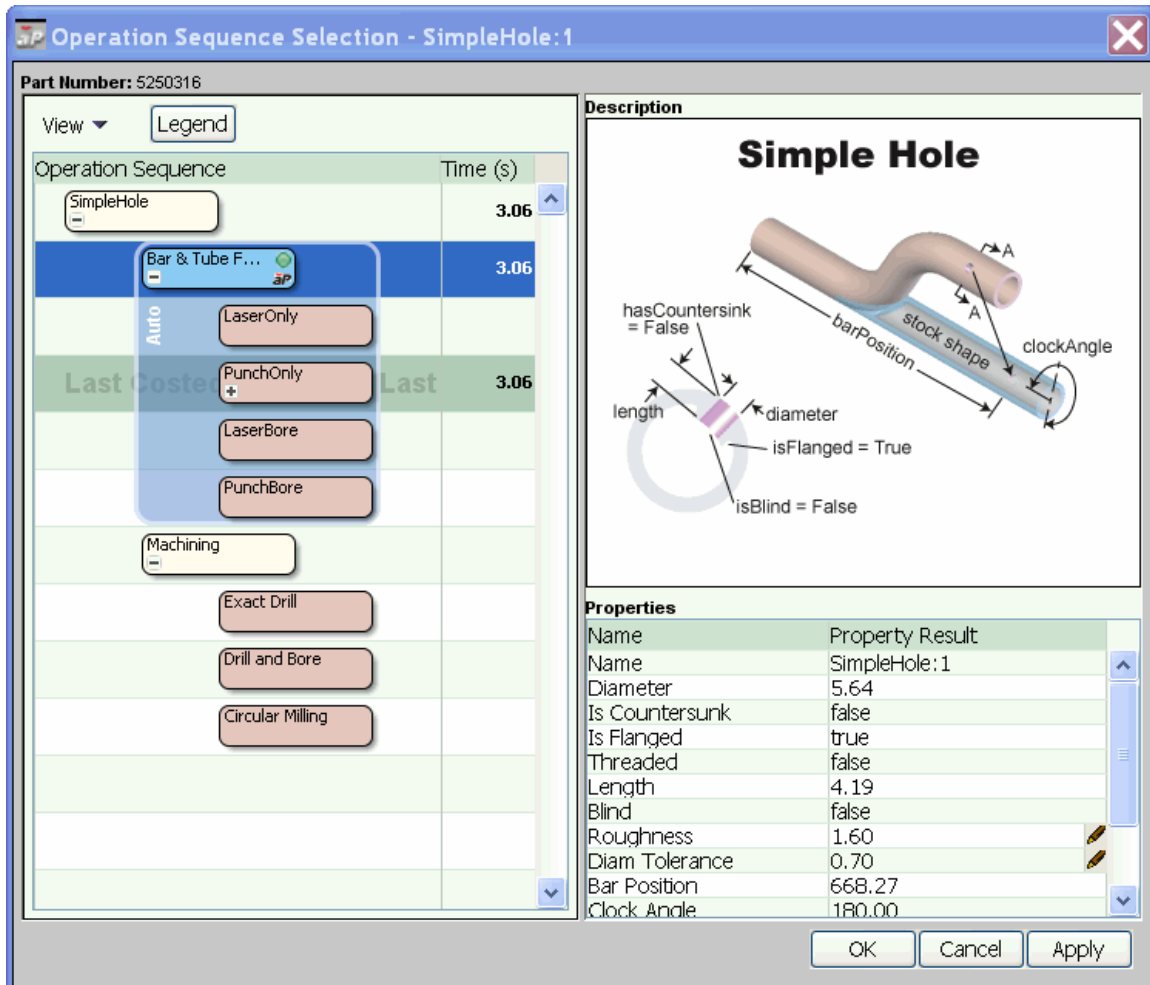
**Properties**

Name	Property	Result
Name	SimpleHole: 1	
Diameter		5.64
Is Countersunk		false
Is Flanged		true
Threaded		false
Length		4.19
Blind		false
Roughness		1.60
Diam Tolerance		0.70
Bar Position		668.27
Clock Angle		180.00

OK Cancel Apply

If you click **OK** or **Apply** at this point, aPriori will automatically select a sequence within the **Auto** border. You can also select a sequence manually.

- If you manually select one sequence under the alternative node, the scope of aPriori auto-select options changes and becomes limited to alternatives within that sequence.



You can again click OK or Apply to let aPriori make a selection within Auto border or make the selection manually.

## Using the right-click menu

Right-clicking a node selects the node and the row and opens a menu with the following options:

- **Inclusion menu** – this option is only available for the nodes that can be manually included into and excluded from the operation sequence:

**Let aPriori decide** – initially this option is selected, since by default aPriori decides whether to include or exclude the node.

**Include** – select this option to manually include the selected node in the operation sequence. The green icon on the node indicates that the node was manually included. Select **Let aPriori decide** to revert to the aPriori choice.


**Exclude** – select this option to manually exclude the selected node from the operation sequence. The node becomes crossed out and the green icon on the node indicates that the node was manually excluded. Select **Let aPriori decide** to revert to the aPriori choice.

- **Tool** – this option is only available for machining operations which have no more underlying operations underneath them. It displays information about the tool selected for the specified operation (see the section "Tool Selection for Machining" in the *aPriori Cost Model Guide*), including tool type and tool family. For information about tool diameter, select **Process Setup Options** from the right-click menu.
- **Process Setup Options** – displays GCD-specific process setup options.
- **Rules/Status** – this option displays the evaluation feasibility status for the node. For nodes representing alternative and optional operations it also displays the **User Selection Policy Options** window. In this window you can:

Check the **Operation** check box to evaluate the operation feasibility rules.

Choose what to do if a rule fails – **Fail to cost** or **Revert to auto-select**.

## GCD properties

The GCD properties are displayed in the Properties table. Fields with the  icon are editable. Double-click on the field and enter a new value.

When in Auto-Costing mode, the component will be costed as soon as the GCD edit is made. When in One Click Costing mode, the component will not be costed as soon as the GCD edit is made. You must explicitly click the **Cost** button. This allows you to make several GCD level edits and cost these changes in a single costing event.

## GCD categories

The details and options available for GCDs vary between components and across process groups. aPriori GCDs are grouped into the following categories:

- Component GCDs
- Volume GCDs
- Bending/forming GCDs
- Holes GCDs
- Surfaces GCDs
- Weld GCDs
- 2-Model GCDs
- GCD relations

## Component GCDs

The Component GCD Category includes the following GCD Types:

- Base Properties
- Blank
- Main Surface



- Parting Line
- Subcomponents

## Base Properties

The Base Properties GCD Type includes a single GCD named Component, which represents the base properties of the component. This GCD is available for all process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Volume (mm <sup>3</sup> )	The volume of the area contained by the GCD.
	Surface Area (mm <sup>2</sup> )	The surface area of the GCD.
	Length (mm)	The length of the GCD.
	Width (mm)	The width of the GCD.
	Height (mm)	The height of the GCD.
	CAD Material Name	The material defined in the CAD model
	CAD Distance Units	The distance units defined in the CAD model
	CAD Mass Units	The mass units defined in the CAD model
	CAD Temperature Units	The temperature units defined in the CAD model
	CAD Time Units	The time units defined in the CAD model.

## Blank

The Blank GCD Type includes a single GCD named Blank, which represents the flattened sheet metal part after the external contour is cut. This GCD is available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Perimeter (mm)	The sum of lengths of all edges in the contour.
	SER Length (mm)	The length of the smallest enclosing rectangle. This value can be edited by you if aPriori determines an incorrect blank size.

Cost drivers		Description
	SER Width (mm)	The width of the smallest enclosing rectangle. This value can be edited by you if aPriori determines an incorrect blank size.
	Thickness (mm)	The thickness or gauge of the sheet metal blank or part (mm). This value is extracted from the CAD model.
	Chamfer Direction	Indicates the direction of the chamfer with respect to the main surface.
	Curved Length (mm)	The sum of lengths of non-straight edges in the contour.
	Is Chamfered	Indicates if the edges of the GCD are chamfered. If true, the edges are chamfered.
	Max Radius (mm)	The maximum radius of the curvature for non-straight edges of the contour. The value equals 0 if all edges are straight.
	Min Radius (mm)	The minimum radius of curvature for non-straight edges of the contour.
	Number of Coining Chains	The number of contiguous chains of coined edges.
	Num Curved Edges	The number of non-straight edges in the contour.
	Num Edges	The number of edges in the contour.
	Straight Length (mm)	The total length of the straight edges on the perimeter of the part.
	Worst Peninsular Ratio	The maximum (Peninsula Length/Peninsula Width) for all peninsula on a contour. Peninsula are the outstanding tabs on a contour of blank or complex hole.
	Worst Peninsular Ratio2	The maximum (Peninsula Length/Peninsula Width <sup>2</sup> ) in 1/mm. Peninsula are the outstanding tabs on a contour of blank or complex hole.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Main Surface

The Main Surface GCD Type includes a single GCD named MainSurface, which represents the surface of the part that remains fixed and predominantly parallel throughout the development of bends and forms. This GCD is available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Technique	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time (s)	The time (in seconds) that it takes to complete work on a GCD or technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Parting Line

The Parting Line GCD Type includes a single GCD named PartingLine, which represents the division of the top/left side of the mold from the bottom/right side of the mold. aPriori automatically determines this GCD. However, you can manually define the parting line. This GCD is available for the Casting process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Draw Direction	The direction in which the mold separates.
	Height (mm)	The height of the GCD.
	Parting Type	The shape of the parting line. This value can be FLAT or NON-FLAT.
	Projected Area (mm <sup>2</sup> )	The projected area from the mold parting line.
	Projected Perimeter (mm)	The perimeter length of the GCD as projected onto a given plane.

## Subcomponents

The Subcomponents GCD Type includes a GCD for each subcomponent (that is, parts and/or sub-assemblies) included in an assembly. These GCDs are available for the Assembly process group. The GCD details include:

Cost drivers	Description
Part Number	The component identifier as specified in the CAD model.
Quantity	The number of a subcomponent's instances in the component.
Weight (kg)	The total finished mass of material in the subcomponent.
Length (mm)	The longest dimension of the subcomponent.
Width (mm)	The widest dimension of the subcomponent.
Height (mm)	The tallest dimension of the subcomponent.
Surface Area (mm <sup>2</sup> )	The total surface area of the subcomponent.
Volume (mm <sup>3</sup> )	The total finished volume of material in the subcomponent.

## Volume GCDs

The Volume GCD Category includes the following GCD Types:

- Stock Trims
- Bulk Removals
- Pockets
- Rings
- Void
- ComboVoid
- AxiGrooves
- Heligroove (Helical Groove)
- SlideBundles
- LifterBundles

### Stock Trims

The Stock Trims GCD Type includes a single GCD named StockTrim, which represents the volume of material removed by roughing with an endmill. The material removed is the material cross-section between the smallest possible box that fits around the finished part (the bounding box) and the material stock that encloses the part times, the bounding box, and the cutoff. The material represented by the Stock Trim GCD typically is first roughed away, and then additional machining is performed to create the features on the finished part.

Stock trim is a virtual GCD. It is computed after aPriori selects the appropriate stock size from the bounding box. This GCD is available for the Machining process group.

For parts machined from rectangular stock, aPriori now displays the Stock Trim GCD in the Component Viewer pane. The stock trim is rendered with red outlines representing the stock surfaces and yellow outlines representing the bounding box.

The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Volume (mm <sup>3</sup> )	The volume of the GCD.
	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the sphere used to calculate the pocket or bulk removal skin.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Min Radius (mm)	The minimum radius found on the GCD. <b>Note</b> The minimum radius is determined in a plane perpendicular to the setup axis from which the GCD is being machined.
	Max Radius (mm)	The maximum radius found on the GCD. <b>Note</b> The maximum radius is determined in a plane perpendicular to the setup axis from which the GCD is being machined.
	Size (mm)	A metric used to drive calculations involving the overall GCD size.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.

	Volume Removal Rate (mm <sup>3</sup> /sec)	The total volume removed per second.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Bulk Removals

The Bulk Removals GCD Type includes one primary BulkRemoval GCD per component. The BulkRemoval GCD includes one BulkRemovalCore nested GCD and zero to many CornerPick nested GCDs. These GCDs are available for the Machining process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the sphere used to calculate the pocket or bulk removal skin.
	Total Volume (mm <sup>3</sup> )	The volume of the GCD.
	Corner Pick Count	The number of corner picks in the GCD.
	Corner Pick Volume (mm <sup>3</sup> )	The total volume of the corner picks in the GCD.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Pockets

The Pockets GCD Type includes the Pocket primary GCD. The Pocket GCD includes one PocketCore nested GCD and zero to many CornerPick nested GCDs. The Pocket GCD exists mainly as a single roll-up entity, enabling the system to hang the cumulative results of creating a pocket core and the associated corner picks. A pocket is a generic volume found inside of the bulk removal skin representing the effort of creating the pocket. These GCDs are available for the Machining process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the sphere used to calculate the pocket or bulk removal skin.
	Total Volume (mm <sup>3</sup> )	The volume of the GCD.
	Corner Pick Count	The number of corner picks in the GCD.
	Corner Pick Volume (mm <sup>3</sup> )	The total volume of the corner picks in the GCD.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Rings

The Rings GCD Type represents an axisymmetric volume of material to be removed. It is available in the Bar and Tube Fabrication, Casting, and Forging process groups. Ring

GCDs are comprised of PlanarFace GCDs and CurvedWall GCDs. Ring GCD Details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Volume (mm3)	The volume of the GCD.
	Axial Section Area (mm2)	Cross section area of the ring, for a plane passing through the axis of rotation.
	Riser Area (mm2)	The total area of all ring-shaped planar faces (annulus) that are children of the ring.
	Tread Area (mm2)	The total area of all curved wall (cylindrical) surfaces that are children of the ring.
	Is Mirror Symmetric	True if the GCD has mirror symmetry about the tool axis; tool axis angle is specified via an isAbout relation.
	Depth (mm)	The depth of the Ring GCD, as measured with respect to the Approach From direction (see below)
	Approach From	The direction from which the machine tool approaches. Possible values include FACE_A, FACE_B, ID, OD, SLANTED, NONE.
	Approach From Alt	An alternative direction of approach of the machine tool. Possible values include FACE_A, FACE_B, ID, OD, SLANTED, NONE.
	Accessibility	Directions from which the GCD can be entered. Possible values include SIDE_A, SIDE_B, THROUGH, UNDERCUT, OBSCURED, UNKNOWN.
	Min Wall Thickness (mm)	The minimum wall thickness of the GCD.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.



Cost drivers		Description
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Void

The Void GCD Type includes the Void GCD, which represents any recess or cavity in the component that is not a hole or multi-step hole. Note that a casting void and a machining pocket can refer to the same geometric entity. These GCDs are available for the Casting and Machining process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Accessibility	The directions from which the GCD can be entered. Possible values include OBSCURED, SIDE_A, SIDE_B, THROUGH, and UNDERCUT.
	Void Direction Accessible	Indicates accessibility in the core movement direction.
	Box Height (mm)	The smallest dimension of the bounding box.
	Box Length (mm)	The longest dimension of the bounding box.
	Box Width (mm)	The middle dimension of the bounding box.
	Exposed Area (mm <sup>2</sup> )	The cumulative area exposed by openings.
	Num Openings	The number of openings exposed to the part exterior.
	Num Surfaces	The number of part surfaces.
	Perimeter (mm)	The sum of lengths of all edges in the contour.
	Surface Area (mm <sup>2</sup> )	The surface area of the GCD.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Void Shape	The classification of the void shape. Possible values include EXTRUDED and COMPLEX.
	Volume (mm <sup>3</sup> )	The volume of the final part.

Cost drivers		Description
	Dir Core Prints Box Height	The number of directions that core prints stick out along the height axis of the smallest enclosing box. 0 = no core prints on either height wise face, 1 = core print(s) stick out of only one face in height wise direction, 2 = core print(s) stick out of both faces in height wise direction.
	Dir Core Print Box Length	The number of directions that core prints stick out along the length axis of the smallest enclosing box. 0 = no core prints on either length wise face, 1 = core print(s) stick out of only one face in length wise direction, 2 = core print(s) stick out of both faces in length wise direction.
	Dir Core Print Box Width	The number of directions that core prints stick out along the smallest enclosing box. 0 = no core prints on either width wise face, 1 = core print(s) stick out of only one face in width wise direction, 2 = core print(s) stick out of both faces in width wise direction.
	Max Tool Diameter (mm)	The largest diameter tool that can machine the GCD.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## ComboVoid

The ComboVoid GCD Type includes one or more ComboVoid GCDs with one or more SimpleHole GCDs. ComboVoid GCDs are required for more advanced merging of cores for Sand Casting. These GCDs are available for the Casting process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Accessibility	The directions from which the GCD can be entered. Possible values include OBSCURED, SIDE_A, SIDE_B, THROUGH, and UNDERCUT.
	Void Direction Accessible	Indicates accessibility in the core movement direction.
	Box Height (mm)	The smallest dimension of the bounding box.
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
	Box Length (mm)	The longest dimension of the bounding box.
	Box Width (mm)	The middle dimension of the bounding box.
	Exposed Area (mm <sup>2</sup> )	The cumulative area exposed by openings.
	Num Openings	The number of openings exposed to the part exterior.
	Num Surfaces	The number of part surfaces.
	Perimeter (mm)	The sum of lengths of all edges in the contour.
	Surface Area (mm <sup>2</sup> )	The surface area of the GCD.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Void Shape	The classification of the void shape. Possible values include EXTRUDED and COMPLEX.
	Volume (mm <sup>3</sup> )	The volume of the final part.
	Dir Core Prints Box Height	The number of directions that core prints stick out along the height axis of the smallest enclosing box. 0 = no core prints on either height wise face, 1 = core print(s) stick out of only one face in height wise direction, 2 = core print(s) stick out of both faces in height wise direction.
	Dir Core Print Box Length	The number of directions that core prints stick out along the length axis of the smallest enclosing box. 0 = no core prints on either length wise face, 1 = core print(s) stick out of only one face in length

Cost drivers		Description
		wise direction, 2 = core print(s) stick out of both faces in length wise direction.
	Dir Core Print Box Width	The number of directions that core prints stick out along the smallest enclosing box. 0 = no core prints on either width wise face, 1 = core print(s) stick out of only one face in width wise direction, 2 = core print(s) stick out of both faces in width wise direction.
	Max Tool Diameter (mm)	The largest diameter tool that can machine the GCD.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

For details about SimpleHole GCDs, refer to *Simple Holes* on page 232.

## AxiGrooves

AxiGrooves are axisymmetric GCDs that represent gears, splines, sprockets, and flutes. Child GCDs of an AxiGroove include the bottoms and sides of the tooth valleys. They do not include the tops of the teeth, and they do not include surfaces normal to the axis of rotation. See the section "Working with Gears, Splines, Sprockets, and Flutes" in the *aPriori Cost Model Guide* for more information. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Approach From	<b>Ap</b> direction of approach of the machine tool: OD (from the outside), ID (from the inside), or NONE.
	Axial Length (mm)	Length of the AxiGroove along turning axis in millimeters.

Cost drivers		Description
	Cone Angle (deg)	Cone angle of the AxiGroove in degrees. This is one half the apex angle of the AxiGroove's root cone. (The gear's axis of rotation is the root cone's axis of symmetry. The surface of the root cone coincides with the bottoms of the tooth valleys.) The angle is 0 for cylindrical AxiGrooves, positive for conical AxiGrooves, and -1 if the valley profile is not cylindrical or conical.
	Distance To Shoulder A (mm)	Distance to the shoulder along the turning axis (in direction A) in millimeters. For external AxiGrooves, this is the distance between the end of the AxiGroove and the closest point on the turning profile that is higher than the valleys between teeth. For internal AxiGrooves, it is the distance to the closest point on the turning profile that is lower than the tooth valleys. A dash, -, is displayed when there is no shoulder.
	Distance To Shoulder B (mm)	Distance to the shoulder along the turning axis (in direction B) in millimeters. For external AxiGrooves, this is the distance between the end of the AxiGroove and the closest point on the turning profile that is higher than the valleys between teeth. For internal AxiGrooves, it is the distance to the closest point on the turning profile that is lower than the tooth valleys. It is -1 when there is no shoulder.
	Groove Depth (mm)	Depth of the grooves in millimeters.
	Helix Angle (deg)	Helix angle of the AxiGroove in degrees. This is positive for right-handed AxiGrooves, and negative for left-handed AxiGrooves.
	Helix Total Twist Angle (deg)	Total twist of the AxiGroove in degrees. This is set to -1 when either of the following holds: <ul style="list-style-type: none"> <li>▪ AxiGroove's inner surface is neither cylindrical nor conical.</li> <li>▪ For external AxiGrooves, the bottom groove points are not on a spiral; for internal AxiGrooves, the top groove points are not on a spiral.</li> </ul>
	Max Diameter (mm)	Maximum diameter of the AxiGroove in millimeters. This is twice the maximum distance from a tooth or valley surface to the turning axis.
	Min Diameter (mm)	Minimum diameter of the AxiGroove in millimeters. This is twice the minimum distance from a tooth or valley surface to the turning axis.

Cost drivers		Description
	Number of Teeth	Number of teeth in the AxiGroove.
	Radial Undercut Volume Ratio	Ratio of the radial undercut volume to the whole volume of the AxiGroove.
	Shoulder Diameter A (mm)	Diameter of the shoulder in direction A in millimeters. For external AxiGrooves this is the largest diameter of the turning profile on one side of the AxiGroove. For internal AxiGrooves it's the smallest diameter. This is -1 for AxiGrooves with no shoulder.
	Shoulder Diameter B (mm)	Diameter of the shoulder in direction B in millimeters. For external AxiGrooves this is the largest diameter of the turning profile on one side of the AxiGroove. For internal AxiGrooves it's the smallest diameter. This is -1 for AxiGrooves with no shoulder.
	Surface Area (mm <sup>2</sup> )	Area of all grooves in mm <sup>2</sup> . This is the area of the walls and bottoms of the tooth valleys. It excludes the area of the tooth faces.
	Tooth To Valley Volume Ratio	Ratio of tooth volume to valley volume.
	Valley Axial Extent	Axial length of valley extent in millimeters. This is the total length of all inner faces of the axigroove adjacent to the turnable (recognized) surfaces.
	Volume (mm <sup>3</sup> )	Volume of axigroove in mm <sup>3</sup> .
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Heligroove (Helical Groove)

Deprecated—see AxiGroove. The Heligroove (helical groove) GCD Type represents a repeating groove with helical symmetry about an axis. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Num Lobes	The total number of lobes about the helix axis.
	Pitch (mm)	The axial distance between grooves (of the same helical groove).
	Groove Angular Span (deg)	The angular span of the groove; the angle is measured at the point of intersection with the external cylinder that encloses it.
	Max Diameter (mm)	The diameter of the groove, about the helical axis, as measured to the top of the lobe.
	Min Diameter (mm)	The diameter of the groove, about the helical axis, as measured to the bottom of the groove.
	Axial Length (mm)	The extent of the helical groove, as measured along the helix axis.
	Surface Area (mm <sup>2</sup> )	The surface area of the helical groove (Note: does not include the area of the outer cylindrical surfaces).
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## SlideBundles

The SlideBundle GCD represents groups of holes or voids that can share a slide. See the section "How aPriori Assigns Holes and Voids to Slides and Lifters" in the aPriori *Cost Model Guide* for more information.

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Start (mm)	Number that indicates the position of the first GCD contained in the bundle. The difference between End and Start is the width of the bundle.
	End (mm)	Number that indicates the position of the last GCD contained in the bundle. The difference between End and Start is the width of the bundle.

## LifterBundles

The LifterBundle GCD represents groups of holes or voids that can share a lifter. See the section "How aPriori Assigns Holes and Voids to Slides and Lifters" in the aPriori *Cost Model Guide* for more information.

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Start (mm)	Number that indicates the position of the first GCD contained in the bundle. The difference between End and Start is the width of the bundle.
	End (mm)	Number that indicates the position of the last GCD contained in the bundle. The difference between End and Start is the width of the bundle.

## Bending/forming GCDs

The Bending/Forming GCD Category includes the following GCD Types:

- Bends
- Multiple Bends
- Forms
- Lances
- ShearForms



- Ends

## Bends

The Bends GCD Type includes one or more StraightBend GCDs, which represent only co-axial cylinders having the same radius. These GCDs are available for the Sheet Metal and Bar and Tube process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Bend Angle (deg)	The total angle that the bend passes through. Unbent, this angle equals 0. A hem equals 180 degrees.
	Clock Angle (deg)	Angle measured in a plane perpendicular to the tube/bar axis
	Bend Direction	Indicates the direction of the bend with respect to the main surface. Possible values include UP, DOWN, BOTH, EITHER, and UNKOWN.
	Bar Position, From (mm)	Distance from the bar origin to the start of the bend GCD.
	Bar Position, To (mm)	Distance from the bar origin to the end of the bend GCD.
	Length (mm)	The length of the GCD.
	Min Bend Radius (mm)	The minimum radius of any bend surface along the chain measured from the bend interior.
	Neutral Bend Radius	Radius of bend measured to the neutral axis.
	Bend Flap Size	The maximum distance between two neighboring bends or a bend and a neighboring blank contour.
	Is Straight	Indicates whether the bend goes along a line axis. If true, the bend is straight.
Is Gusset	Indicates whether the bend has a gusset (a special type of emboss) put across the bend as a strengthener.	
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful; a

Cost drivers		Description
		yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Multiple Bends

The Multiple Bends GCD Type includes one or more Multibend GCDs with one or more StraightBend GCDs. Multibends GCDs represent the merging together of two or more bends. These GCDs are available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Bend Angle (deg)	The total angle that the bend passes through. Unbent, this angle equals 0. A hem equals 180 degrees.
	Bend Direction	Indicates the direction of the bend with respect to the main surface. Possible values include UP, DOWN, BOTH, EITHER, and UNKOWN.
	Length (mm)	The length of the GCD.
	Min Bend Radius (mm)	The minimum radius of any bend surface along the chain measured from the bend interior.
Technique	Bend Flap Size	The maximum distance between two neighboring bends or a bend and a neighboring blank contour.
	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

For details about StraightBend GCDs, see [Bends on page 227](#).

## Forms

The Forms GCD Type includes one or more Form GCDs, each representing a deformation of metal other than bends. Usually, this is achieved by pressing a shaped punch into the material from one side. The far side can either deflect or not. Depending

on their aspect ratios, forms are made by a variety of operations: coining/swaging when the metal thickness is significantly changed, embossing when the deformation depth is relatively shallow, drawing when the metal is significantly stretched, and deep drawing when the metal is extremely stretched. These GCDs are available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Area (mm <sup>2</sup> )	The area of the GCD in a flattened state.
	SER Length (mm)	The length of the smallest enclosing rectangle.
	SER Width (mm)	The width of the smallest enclosing rectangle.
	Sub Type	The sub type of the current GCD type. Possibilities include TAB, BRIDGE, EMBOSS, and STAMP.
	Depth Down (mm)	The depth of the form. This is measured as the maximum distance that any point on the form's main surface is displaced. It is always a positive number.
	Depth Up (mm)	The depth of the form. This is measured as the maximum distance that any point on the form's main surface is displaced. It is always a positive number.
	Perimeter (mm)	The sum of lengths of all edges in the contour.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Lances

The Lance GCD Type includes one or more Lance GCDs, each representing a slit in the sheet metal requiring no material loss. Usually, a lance lies on a form. Lances are rarely, if ever, made by themselves. Normally, they occur next to a form to make design features such as louvers or bridges. Lancing and forming are usually done at a single die. These GCDs are available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Length (mm)	The length of the GCD. The length is measured in the flattened state.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## ShearForms

The ShearForms GCD Type includes one or more ShearForm GCDs, each with a Form GCD combined with one or more Lance GCDs. These GCDs are available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Area (mm <sup>2</sup> )	The area of the GCD in a flattened state.
	SER Length (mm)	The length of the smallest enclosing rectangle.
	SER Width (mm)	The width of the smallest enclosing rectangle.
	Sub Type	The sub type of the current GCD type. Possibilities include TAB, BRIDGE, EMBOSS, and STAMP.
	Depth Down (mm)	The depth of the form. This is measured as the maximum distance that any point on the form's main surface is displaced. It is always a positive number.
	Depth Up (mm)	The depth of the form. This is measured as the maximum distance that any point on the form's main surface is displaced. It is always a positive number.
	Length (mm)	The length of the GCD. For ShearForm, this is the combined length of all lances.
	Perimeter (mm)	The sum of lengths of all edges in the contour.

Cost drivers		Description
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Ends

The Ends GCD Type includes one or more End GCDs. These GCDs are available for the Bar and Tube process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Area (mm <sup>2</sup> )	The area of the GCD.
	Bar Position (mm)	Distance from the bar origin to the GCD location on the bar.
	Is Planar?	True if the GCD consists entirely of planes with convex edges.
	Maximum Cut Angle (deg)	Maximum angle between a plane in the GCD and the plane perpendicular to the stock axis.
	Number of Planes	The count of plane surfaces contained within a GCD.
	Outer Perimeter (mm)	Perimeter measured along the outside of the part.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.

## Holes GCDs

The Holes GCD Category includes the following GCD Types:

- Simple Holes
- Complex Holes
- Multi Step Holes

- Ringed Holes

## Simple Holes

The Simple Holes GCD Type includes one or more SimpleHole GCDs, each representing an unbroken 360-degree hole having a circular cross section on one of the sheet metal faces. These GCDs are available for the Casting, Machining, and Sheet Metal process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Diameter (mm)	The diameter of the hole interior where the hole is in its final shape.
	Is Countersunk	Indicates whether or not the GCD has a countersink. If true, the GCD has a countersink.
	Is Flanged	Indicates whether or not the GCD has a flange. If true, the GCD has a flange.
	Countersink Direction	Indicates the direction of the countersink with respect to the main surface. Possibilities include UP, DOWN, BOTH, EITHER, and UNKOWN.
	Flange Direction	Indicates the direction of the flange with respect to the main surface. Possibilities include UP, DOWN, BOTH, EITHER, and UNKOWN.
	Length (mm)	The length of the GCD.
	Blind	Indicates whether or not the GCD passes entirely through the part. True if the bottom of the GCD passes out of the other side of the part.
	Cone Angle (deg)	An angle $\leq 90$ degrees measured from the hole's central axis. Through holes have their cone angle set to 90 degrees. <b>Note</b> Cone angle is not currently used for tool feasibility, but it is used to compute the total drilling stroke. Through holes should have their cone angle set to 90 degrees.
	Roughness ( $\mu\text{m}$ )	The average roughness of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.
	Threaded	Indicates whether or not the hole is threaded. If true, the hole is threaded.

Cost drivers		Description
	Diam Tolerance (mm)	The diametrical tolerance of a hole. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Position Tolerance (mm)	The tolerance on the location of the center line of a hole. <b>Note</b> For a hole, this specifies the diameter of a cylinder that the center of a hole must be within. If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Parallelism (mm)	The parallelism tolerance of a hole. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.
	Perpendicularity (mm)	The perpendicularity tolerances of a hole. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.
	Runout (mm)	The runout tolerance of a hole. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.
	Volume (mm <sup>3</sup> )	The volume of the final part.
	Surface Area (mm <sup>2</sup> )	The surface area of the GCD.
	Min Wall Thickness (mm)	The minimum wall thickness of the GCD.
	Accessibility	The directions from which the GCD can be entered. Possible values include OBSCURED, SIDE_A, SIDE_B, THROUGH, and UNDERCUT.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is

Cost drivers		Description
		more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Complex Holes

The Complex Holes GCD Type includes one or more ComplexHole GCDs, each representing a non-circular interior contour. Note that flanges around a complex hole are not recognized as a hole property (they are recognized as a separate form). A lance is recognized as a complex hole with zero area. These GCDs are available for the Sheet Metal process group. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Area (mm <sup>2</sup> )	The area of the GCD in a flattened state.
	Sec Diameter (mm)	The diameter of the smallest circle that will fit around the GCD.
	Mec Diameter (mm)	The diameter of the largest circle fitting into the hole.
	Perimeter (mm)	The sum of the lengths of all edges in the contour.
	SER Length (mm)	The length of the smallest enclosing rectangle.
	SER Width (mm)	The width of the smallest enclosing rectangle.
	Tolerance/Profile of Surface (mm)	The most constraining tolerance among the dimensions defining the GCD. You can view it as a +/- tolerance. Tolerance is persisted and computed as a total tolerance by the system. Note: If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Roughness (µm)	The average roughness of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.



Cost drivers		Description
	Chamfer Direction	Indicates the direction of the chamfer with respect to the main surface. Possibilities include UP, DOWN, BOTH, EITHER, and UNKNOWN.
	Flange Direction	Indicates the direction of the flange with respect to the main surface. Possibilities include UP, DOWN, BOTH, EITHER, and UNKNOWN.
	Is Chamfered	Indicates whether or not the edges of the GCD are chamfered. If true, the edges are chamfered.
	Is Flanged	Indicates whether or not the GCD has flange. If true, the GCD has a flange.
	Max Radius (mm)	The maximum radius of curvature for non-straight edges in the contour. Equals 0 if all edges are straight.
	Min Radius (mm)	The minimum radius of curvature for non-straight edges in the contour.
	Number of Coining Chains	The number of contiguous chains of coined edges.
	Num Curved Edges	The number of non-straight edges in the contour.
	Num Edges	The number of edges in the contour.
	Num Straight Edges	The number of straight edges in the contour.
	Worst Peninsular Ratio	The maximum (Peninsula Length/Peninsula Width) for all peninsula on a contour. Peninsula are the outstanding tabs on a contour of blank or complex hole. ("Peninsular ratio" used for the stamping processes such as progressive die to determine what elements on a part can be grouped together for punching.)
	Worst Peninsular Ration2	The maximum (Peninsula Length/Peninsula Width <sup>2</sup> ) in 1/mm. Peninsula are the outstanding tabs on a contour of blank or complex hole.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a

Cost drivers	Description
	warning, and a red icon indicates that costing failed.

## Multi Step Holes

The Multi Step Holes GCD Type includes one or more GCDs with one or more SimpleHole GCDs. A multi-step hole is the generalization of the counterbored hole. It is a counterbored hole with an arbitrary number of steps. aPriori estimates the manufacturing time by splitting it into a set of simple holes, each hole representing one step. The results of the individual computations are summed together by aPriori. Any additional one-time estimating elements are also added. The step diameter sizes must be monotonically decreasing. These GCDs are available for the Casting and Machining process groups. The GCD details include:

Cost drivers	Description	
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Max Diameter (mm)	The maximum diameter of the GCD.
	Min Diameter (mm)	The minimum diameter of the GCD.
	Min Tolerance (mm)	The minimum tolerance of the GCD. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Total Length (mm)	The length of the GCD.
	Total Volume (mm <sup>3</sup> )	The volume of the final part.
	Step Count	The total number of hole steps.
	Countersink Count	The total number of countersinks in the hole.
	Blind	Indicates whether or not the GCD passes entirely through the part. True if the bottom of the GCD passes out of the other side of the part.
	Accessibility	The directions from which the GCD can be entered. Possible values include OBSCURED, SIDE_A, SIDE_B, THROUGH, and UNDERCUT.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.

Cost drivers		Description
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Ringed Holes

The RingedHole GCD Type is created only for routings which contain Turning processes (Lathes) and is used to support parts with internal turned geometry. It includes a SimpleHole GCD which represents the smallest interior diameter of the part, and one or more Ring GCDs which represent additional internal co-axial volumes. The RingedHole GCDs is available for the Bar & Tube, Casting, and Forging process groups.

## Surfaces GCDs

The Surfaces GCD Category includes the following GCD Types:

- Planar Faces
- Curved Walls
- Curved Surfaces
- Sharp Edge

### Planar Faces

The Planar Faces GCD Type includes one or more PlanarFace GCDs, each representing any flat surface to be finished. Depending on the orientation of the setup axis with the surface, this GCD may be machined by face milling, side milling, or ballnose finishing (kellering). Under some conditions, finish machining is assumed to be combined with bulk machining. Under other conditions of little or no bulk machining, separate finish machining is required. Tools normal to the surface are assumed to perform facing. Tools parallel to the surface are assumed to perform side milling. Finally, tools oblique to the surface are assumed to perform kellering. Knowing the normal to the face and the associated setup axis direction, aPriori can compute the required finishing process. These GCDs are available for the Casting and Machining process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Finished Area (mm <sup>2</sup> )	The area that requires finishing machining.
	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the sphere used to calculate the pocket or bulk removal skin.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Bend Diameter (mm)	The bend diameter of the surface. The surface's smallest positive curvature (edges curved toward viewer). If there is no positive curvature, Bend Diameter = -1.
	Tolerance/Profile of Surface (mm)	The most constraining tolerance among the dimensions defining the GCD. You can view it as a +/- tolerance. Tolerance is persisted and computed as a total tolerance by the system. <b>Note:</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Roughness (μm)	The average roughness of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD.
	Flatness (mm)	The flatness tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Parallelism (mm)	The parallelism tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Perpendicularity (mm)	The perpendicularity tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that

Cost drivers		Description
		the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	On Bounding Box	Indicates whether the part's face coincides with the bounding box. If true, the face coincides with the bounding box. This property allows the system to decide whether the required finish can be achieved simultaneously by the bulk milling operation.
	Direction Type	Indicates the direction type. 1 = normal to surface, 2 = parallel to surface, and 3 = oblique to surface.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Surface Finishing Rate (mm <sup>3</sup> /sec)	The total volume finished per second.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Curved Walls

The Curved Walls GCD Type includes one or more GCDs, each representing a tabular cylinder, possibly with a  $\leq 5$ -degree draft. This surface can be machined by side milling or kellering. Knowing the wall direction and the direction of the associated setup axis, aPriori can compute whether this surface requires side milling or kellering. These GCDs are available for the Casting and Machining process groups. The GCD details include:

Cost drivers		Description
GCD	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Finished Area (mm <sup>2</sup> )	The area that requires finishing machining.
	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching

Cost drivers		Description
		other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the sphere used to calculate the pocket or bulk removal skin.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Bend Diameter (mm)	The bend diameter of the surface. The surface's smallest positive curvature (edges curved toward viewer). If there is no positive curvature, Bend Diameter = -1.
	Threaded	Indicates whether or not the surface is threaded. Used with the "Thread Length (mm)" property (see below)
	Thread Length (mm)	Used for threaded surfaces (Threaded = True) to indicate the extent of threading on the curved wall surface.
	Tolerance/Profile of Surface (mm)	The most constraining tolerance among the dimensions defining the GCD. You can view it as a +/- tolerance. Tolerance is persisted and computed as a total tolerance by the system. Note: If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Roughness (µm)	The average roughness of the GCD surface. Note: If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient surface finish capability to manufacture the GCD..
	Circularity	The circularity tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Concentricity	The concentricity tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Cylindricity	The cylindricity tolerance of the GCD surface.

Cost drivers		Description
		<b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Perpendicularity	The perpendicularity tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Runout	The runout tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Straightness	The straightness tolerance of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	On Bounding Box	Indicates whether the part's face coincides with the bounding box. If true, the face coincides with the bounding box. This property allows the system to decide whether the required finish can be achieved simultaneously by the bulk milling operation.
	Direction Type	Indicates the direction type. 1 = normal to surface, 2 = parallel to surface, and 3 = oblique to surface.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time(s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Surface Finishing Rate (mm <sup>3</sup> /sec)	The total volume finished per second.
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a

Cost drivers		Description
		warning, and a red icon indicates that costing failed.

## Curved Surfaces

The Curved Surfaces GCD Type includes one or more CurvedSurface GCDs, each representing a GCD with areas of double curvature, requiring the use of a ballnose mill or equivalent rounded tool. The machining process is always kellering. For a curved surface, the tool is always assumed oblique to the surface. aPriori does know during which setup that a curved surface will be machined, so there is no association with the axis ID. These GCDs are available for the Casting and Machining process groups. The GCD details include:

Cost drivers		Description
GCDs	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Finished Area (mm <sup>2</sup> )	The area that requires finishing machining.
	Max Tool Diameter (mm)	For surfaces, this is the largest tool diameter entering from a given setup axis without touching other part surfaces. If there is no limiting diameter, Max Tool Diameter = -1. For pockets and bulk removal, this is the diameter of the of the sphere used to calculate the pocket or bulk removal skin.
	Tool Reach (mm)	The minimum tool reach required to contact the bottom surface from the part exterior in the direction of the setup axis. For an exterior surface, Tool Reach = 0.
	Bend Diameter (mm)	The bend diameter of the surface. The surface's smallest positive curvature (edges curved toward viewer). If there is no positive curvature, Bend Diameter = -1.
	Tolerance (mm)	The most constraining tolerance among the dimensions defining the GCD. You can view it as a +/- tolerance. Tolerance is persisted and computed as a total tolerance by the system. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Roughness (µm)	The average roughness of the GCD surface. <b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	Runout	The runout tolerance of the GCD surface.



Cost drivers		Description
		<b>Note</b> If set to <unspecified>, aPriori assumes that the chosen manufacturing process and operations have sufficient tolerance capability to manufacture the GCD.
	On Bounding Box	Indicates whether the part's face coincides with the bounding box. If true, the face coincides with the bounding box. This property allows the system to decide whether the required finish can be achieved simultaneously by the bulk milling operation.
	Direction Type	Indicates the direction type. 1 = normal to surface, 2 = parallel to surface, and 3 = oblique to surface.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time (s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.
	Surface Finishing Rate (mm <sup>3</sup> /sec)	The total volume finished per second
	Status	The costing status of the GCD or technique. A green icon indicates that costing was successful, a yellow icon indicates that costing succeeded with a warning, and a red icon indicates that costing failed.

## Sharp Edge

The Sharp Edge GCD Type includes one or more SharpEdge GCDs, each representing a pair of surfaces intersecting along a zero or nearly zero radius internal or external edge. This GCD will be used to automatically identify surfaces to machine. Below a certain radius, casting cannot produce a sharp enough edge. When this happens, the surfaces that the edge lies on must be machined. Adjacent sharp edges (that is, with connecting endpoints) having the same radius and Convex value will be merged into a single edge. These GCDs are available for the Casting process group.

Note that Sharp Edge GCDs are not viewable by default. To view these GCDs, select Show > All. The GCD details include:

Cost drivers		Description
GCDs	Name	The name and number that identifies the GCD. This information is an identifier only and is not used in any cost calculation.

Cost drivers		Description
Properties	Edge Length (mm)	The length of the corner edge.
	Round Radius (mm)	The radius of the round.
	Convex	Indicates whether the edge is convex. If true, the edge is convex.
Technique	Requested	The technique selected by you. If you have not selected a technique, this field is set to auto-select.
	Selected	The technique used by aPriori. If the requested technique cannot be used, aPriori will select a technique that can be used.
Results	Time (s)	The time (in seconds) that it takes to machine the GCD or complete work on a technique. If there is more than one occurrence of the GCD or technique, this field shows the sum of the occurrences.

## Weld GCDs

The Weld GCDs include:

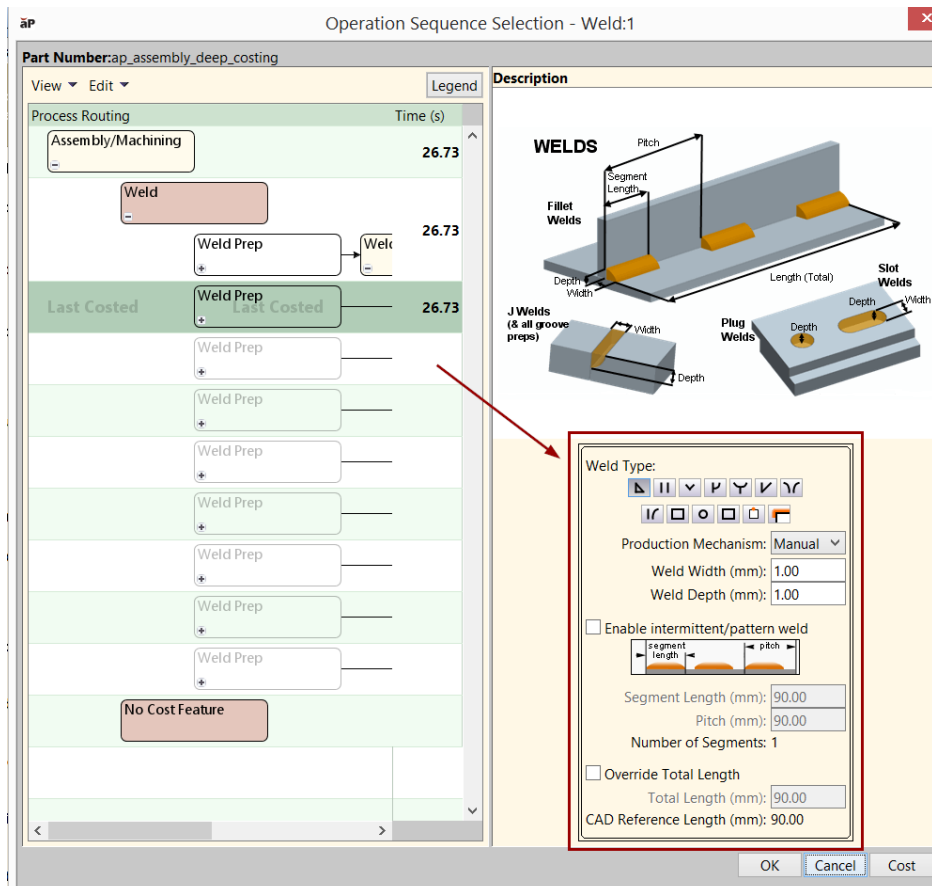
- Pro Welds: created in the CAD model, through the use of Creo with the Pro/Welds module.  
**Note:** Pro welds are available in aPriori *only when you are working in Creo Direct Integration mode*.
- Virtual Welds: created in the aPriori Viewer, with the Welding tool. See *Virtual welds* in *Using the component viewer tools and commands*.

These GCDs are available for the Assembly process group. Each weld GCD represents an individual weld on the assembly. The GCD details include:

Cost drivers		Description
GCDs	Name	The number that identifies the weld. This information is an identifier only and is not used in any cost calculations.
	Type	The type of weld. Possibilities include Fillet, Square Groove, V-Groove, J-Groove, U-Groove, Bevel Groove, Flared V-Groove, Flared Bevel Groove, Plug, Spot, Slot, Tack, and Wrap Tie.  Certain less-common weld types of Creo Welds, such as butt welds, are not fully supported by aPriori. If such a weld is imported into aPriori, the Type property is set to <b>UNKNOWN</b> , and the weld fails to cost. You can edit the weld

Cost drivers		Description
		to select one of the available weld types, in order to approximate the cost.
Properties	Interval	Indicates whether the weld is intermittent/pattern or continuous/individual.
	Total Length (mm)	The total length of a weld.
	Width (mm)	The face width of the weld; for fillet welds, this is the leg 1 length.
	Depth (mm)	The depth of the weld; for fillet welds, this is the leg 2 length.
	Segment Length (mm)	The length of the weld segment in an intermittent/pattern weld.
	Pitch (mm)	Distance from beginning to beginning of an intermittent/pattern MIG weld or spot weld.
	# Segments	The number of segments used in an intermittent/pattern weld.
	CSA (mm <sup>2</sup> )	The cross sectional area of the weld (where applicable).
	Volume (mm <sup>3</sup> )	The total finished volume of material in the weld.
Technique	Method	Indicates whether the weld method is robotic/automated or manual.
Status		Indicates whether the GCD is costable in aPriori. Green indicates that the GCD is costable; red indicates that the GCD is not costable.

You can edit certain weld properties, such as **Type**, **Depth**, and **Width**, by right-clicking a Weld GCD (in the Manufacturing Process or Geometric Cost Drivers pane) and selecting **Edit Operation**. The Welding dialog is displayed in the lower right-hand pane of the Operation Sequence dialog:



This dialog allows you to specify **Type**, **Width**, **Depth**, **Segment Length**, **Pitch**, and **Total Length**, as well the **Production Mechanism** for the weld (Manual or Robotic). aPriori computes the weld's **Volume**, **CSA** (cross-sectional area), and **Number of Segments** based on the other properties.

Note that overriding a Pro weld in aPriori does not affect the definition of the weld in the Creo CAD model. However, the overrides remain in effect in aPriori, even as the CAD model is updated in Creo. To remove the overrides for a given Pro Weld GCD, and revert to using the CAD-defined values, open the Cost Overrides Summary dialog, right-click the weld(s) of interest, and select **Remove Override** from the popup menu.

In some cases, if aPriori is unable to obtain the width of a Pro weld from the values specified in the CAD model, it estimates the width from the actual as-modeled surface weld geometry (for "surface-type" welds), or it estimates the width based on the weld depth. For more information, see Pro Welds in the Assembly Welds section of the Assembly Process Group chapter in the *Cost Model Guide*.

If aPriori is unable to obtain the width of a Pro weld from the values specified in the CAD model, and it uses neither of the above estimation methods, the width is set to 0.

aPriori sets to 0 width, depth, and length values that it is unable to obtain or estimate. Welds with 0-valued width, depth, or length have 0 volume. In starting point VPEs, such welds fail to cost. To address missing dimension values, users can either update the Creo model parameters in Creo, or override the weld properties in aPriori.

See also *Virtual welds*.

## 2-Model GCDs

The 2-Model Machining process group extracts two GCDs in addition to the other GCDs used in the Machining cost model:

- source model
- flat

For a detailed discussion of these GCDs, see the section "2-Model GCDs" in the aPriori *Cost Model Guide*.

Cost drivers		Description
GCDs	Source Model	Allows you to visualize the difference between the initial raw part (the "source" model) and the finished machined part by displaying a transparent representation of the source model while you are viewing the finished model.
	Flat	Represents geometry that is typically spot-faced (for example, to clean off a surface so that it mates better with another part or fastener). It typically is generated only for geometry that is milled and not turned, as Ring GCDs typically will be generated for turned geometry

## GCD relations

The GCD Relations Category indicates relations between GCDs on component. It includes the following GCD relation types:

- Ends On
- Intersects
- Lies Near
- Lies Outside
- Parallel

### Ends On

The Ends On GCD Relation Type indicates when the end edge of the first GCD lies on the contour of the second GCD. The GCD details include:

Cost drivers		Description
GCDs	First	The name and number that identifies the first GCD. This information is an identifier only and is not used in any cost calculation.
	Second	The name and number that identifies the second GCD. This information is an identifier only and is not used in any cost calculation.

## Intersects

The Intersects GCD Relation Type indicates when a portion of the two GCD boundaries are coincident or touching at one or more points, or when the boundary of one lies inside the boundary of another. The GCD details include:

Cost drivers		Description
GCDs	First	The name and number that identifies the first GCD. This information is an identifier only and is not used in any cost calculation.
	Second	The name and number that identifies the second GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Distance (mm)	The distance between the second GCD and the curved part of the emboss.
	Is Planar	Distance is computed only if this value is True.

## Lies Near

The Lies Near GCD Relation Type indicates when the distance between the two GCDs is less than the recognition distance defined for the combination of GCD types and their attribute values. The GCD details include:

Cost drivers		Description
GCDs	First	The name and number that identifies the first GCD. This information is an identifier only and is not used in any cost calculation.
	Second	The name and number that identifies the second GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Distance (mm)	The minimum distance between the boundaries between two non-intersecting GCDs.

## Lies Outside

The Lies Outside GCD Relation Type indicates the main surface is defined and the first GCD lies in the same bend step path as the second GCD, and there are less 'steps' along the path to get to any blank edge in increasing distance for the first GCD than for the second GCD. The GCD details include:

Cost drivers		Description
GCDs	First	The name and number that identifies the first GCD. This information is an identifier only and is not used in any cost calculation.

Cost drivers		Description
	Second	The name and number that identifies the second GCD. This information is an identifier only and is not used in any cost calculation.

## Parallel

The Parallel GCD Relation Type indicates that both bends are straight and end on the same GCD, and the distance between the bend axes are less than a given recognition distance, and the angle between them is less than some constant. The GCD details include:

Cost drivers		Description
GCDs	First	The name and number that identifies the first GCD. This information is an identifier only and is not used in any cost calculation.
	Second	The name and number that identifies the second GCD. This information is an identifier only and is not used in any cost calculation.
Properties	Angle (deg)	The angle between the straight axes of the bends. The relation can only be established between two bends with Is Straight equal to True.
	Distance (mm)	The maximum distance between the bend axes.

## 9 aPriori Cost Tables

This chapter explains how to display cost information about objects in aPriori, using system-defined and custom table views.

---

This chapter includes the following topics:

- Overview
  - Cost Summary
  - Part Details and Assembly Details
  - Investment
  - Assembly tracker
  - Assembly process detail
  - Creating new views
-



## Overview of the cost tables

All cost objects in aPriori have a common cost result structure. For example, each cost object has variable costs, fixed costs, and period overhead. The variable costs are made up of material, labor, direct overhead, and other direct costs.

aPriori provides cost information and guidance for parts and assemblies in a series of views, each shown in its own tab:

- **Part Summary** (New in aPriori 2016 R1) -- aggregated key cost information targeted for design engineers and other non-cost experts.
- **Design to Cost** (New in aPriori 2016 R2)— a series of tabs and panes providing detailed guidance and functionality enabling design engineers to identify and address possible cost savings. Initially available only for the **Stock Machining** and **Plastic Molding** process groups.
- **Cost Summary** – summarized costing information for a part or an assembly.
- **Part Details** and **Assembly Details** – detailed information about manufacturing times and costs for a part or assembly, respectively. The Part Details and Assembly Details tabs provide some standard out-of-the-box views and also can be configured by users to display specific views, containing specific sets of information.

The **Assembly Details** tab also provides some predefined views for convenience, including the Assembly Process Detail view.

- **Investment** – information about the hard tooling, fixturing, programming, and other amortized investment expenses.
- **Assembly Tracker** – graphically summarizes and presents assembly and subcomponent cost information in pie charts and bar charts.

Each view, except for the **Part Summary**, **Design to Cost**, and the **Assembly Tracker**, provides Current, Previous, and Last Saved information.

Cost outputs for Roll-ups, Comparisons, and Analyses, show the following:

- For a Roll-up – the sum of cost details of all the components included in the Roll-up.
- For a Comparison – cost details for each component included in the Comparison on a separate line. This provides a convenient way to compare cost details.
- For an Analysis – cost details for each component included in the Analysis on a separate line. Additional tools are provided to analyze the price difference.

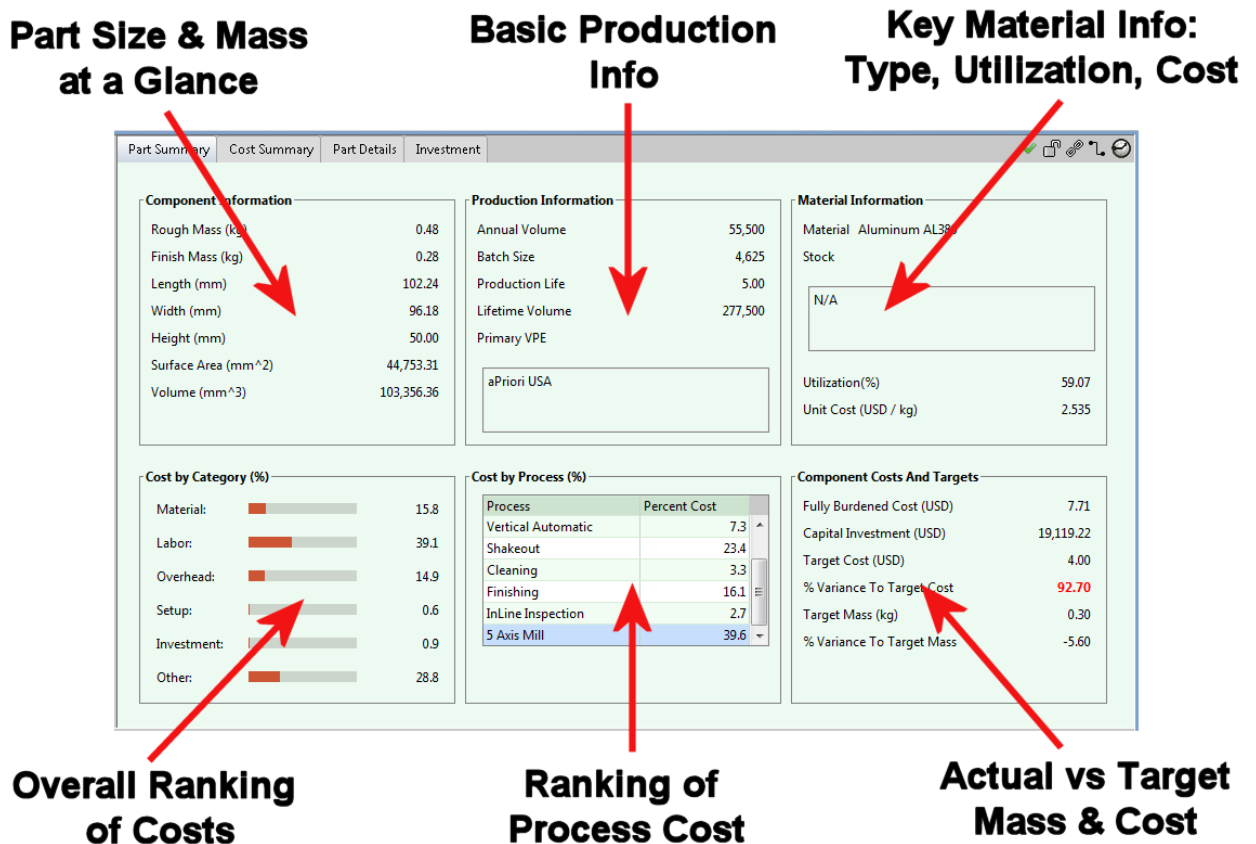
### A note about Fully Burdened Cost

aPriori provides a plant variable named "disableInvestmentAmortization", which enables you to control whether Amortized Tooling and other Investment Costs are included in the Fully Burdened Cost of a component, to correspond with your organization's cost accounting practices. At some sites, accounting practices are such that tooling and other capital costs are attributed to a separate budget and are not considered part of the component's Fully Burdened Cost, nor should they affect the determination of the lowest cost routing. By default, this plant variable is set to FALSE and tooling/investment costs

are included in Fully Burdened Cost. Note that if you want to enable this setting, you must set it to TRUE for each VPE and process group where these accounting practices apply, including those for secondary processes.

## Part Summary tab

The Part Summary tab pulls together key cost information from across the aPriori user interface and summarizes it in a single view. Some displayed values are extracted from other areas of aPriori like the Part Details tab, while others are calculated on the fly by the Part Summary tab to make the information easier to understand. The Part Summary tab displays information that focuses on material, geometry and high-level production information.



The fields in the Part Summary are not editable or overridable like they are in the Part Details tab. The Part Summary tab is displayed only for parts, not for assemblies.

Examine the different panes to quickly identify areas of cost that exceed targets and expectations, and which could be targeted for cost reduction at the design level.

The following sections show where the Part Summary extracts its values. You can go to these more detailed sections of the UI to drill down for more information when necessary.

## Component Information

This mass and part size summary combines information from the Component properties of the Geometric Cost Drivers panel and the Component Mass section of the Part Details tab:

The image shows three windows from the aPriori software interface:

- Component Information:** A summary box on the left containing:
  - Rough Mass (kg): 0.48
  - Finish Mass (kg): 0.28
  - Length (mm): 102.24
  - Width (mm): 96.18
  - Height (mm): 50.00
  - Surface Area (mm<sup>2</sup>): 44,753.31
  - Volume (mm<sup>3</sup>): 103,356.36
- Geometric Cost Drivers:** A tree view on the left and a table on the right. The table lists properties and their results:
 

Name	Property Result
Volume (mm <sup>3</sup> )	103,356.36
Surface Area (mm <sup>2</sup> )	44,753.31
Length (mm)	102.24
Width (mm)	96.18
Height (mm)	50.00
Envelope Centroid	(-0.58, -6.33, 22.00)
Number Of Surfaces	466
Avg Thickness (mm)	7.91
Min Thickness (mm)	2.00
Max Thickness (mm)	25.55
CAD Material Name	Not_Assigned
CAD Distance Units	mm
CAD Mass Units	kg
CAD Temperature Units	C
- Part Summary / Cost Summary / Part Details / Investment:** A table at the top right showing component mass data:
 

Cost Object	Status	Name	Scenario	Quantity	Finish Mass (kg)	Scrap Mass (kg)	Rough Mass (kg)
Current	●		initial	34	0.28	0.20	0.48
Casting	●			75	0.28	0.20	0.48
Sand Casting	●			75	0.28	0.20	0.48
Machining	●			59	0.00	-	-

Red arrows indicate the flow of information: from the Component Information box to the Component Mass section of the Part Details tab, and from the Geometric Cost Drivers table to the Component Information box.

## Production Information

This summary of production info comes from values found on the Cost Guide (and replicated in the Cost Object window). **Lifetime Volume** is calculated by the Part Summary tab from the **Annual Volume** and **Production Life** values.

The image shows two windows from the aPriori software interface:

- Cost Guide:** A configuration window with the following settings:
  - Production Scenario: 1
  - GCD Tolerances: 2
  - Process and Machine Options: 3
  - VPE: aPriori USA
  - Process Routing:  with aPriori-computed routing,  with No optional process overrides
  - Material: Aluminum AL380
  - Volume and Batch Size: 55,500 annually for 5.00 yrs,  in batches of aPriori-computed (4,625)
- Production Information:** A summary box on the left containing:
  - Annual Volume: 55,500
  - Batch Size: 4,625
  - Production Life: 5.00
  - Lifetime Volume: 277,500
  - Primary VPE: aPriori USA
- Part Summary:** A window at the bottom right showing:
  - Part Number: cast\_gearbox\_rear\_a
  - Process Group: Casting
  - VPE: aPriori USA
  - Material: Aluminum AL380
  - Annual Volume: 55,500
  - Production Life: 5.00
  - Costing Method: aPriori
  - Batch Size: Auto (4,625)

A red box highlights the formula: **Lifetime Volume = (Annual Volume x Production Life)**. Red arrows point from this box to the Lifetime Volume value in the Production Information box and to the Annual Volume and Production Life fields in the Part Summary window.

## Material Information

The Material Information panel summarizes information that can be found in the Material Info section of the Part Details tab and the Material Selection window (available from the Manufacturing Process panel).

A low **Utilization (%)** value can alert you to possible actionable issues. For example, a cast part is typically a "near net" shape and should have a high utilization part. A high **Unit Cost** might indicate a design element that requires a premium material. Values that depart from expectations can indicate something to explore.

The screenshot displays three main components of the aPriori software interface:

- Material Information Panel (Left):** Shows details for Material Aluminum AL380. The Stock field is empty (N/A). Utilization(%) is 59.07 and Unit Cost (USD / kg) is 2.535.
- Material Selection Window (Bottom):** Shows the material selection process for Aluminum AL380. It includes a table of material options, a 'Material Unit Cost' section, and a 'Material Utilization' section. The 'Results' section at the bottom shows:
 

Material Cost (USD)	Fully Burdened Cost (USD)	Utilization (%)
▲ 1.22	▲ 6.90	▲ 59
- Table View (Top):** A summary table of material information:
 

Status	Name	Scenario	Material Composition	Material Catalog	Material Unit Cost (USD / kg)	Utilization (%)	Parts Per Sheet	Utilization Mode
Current		initial	Aluminum AL380	aPriori USA	2.535	59		Computed
	Casting					59		
	Machining					100		

Note that if you are working with a process group that uses stock material, such as Sheet Metal, Bar & Tube, etc.), the "Stock" field of the Material Information panel will be populated with relevant info from the Material Stock section of the Material Selection window:

**Material Information**

Material Steel, HR, AISI 1010

Virtual Stock

Steel, HR, AISI 1010: (Virtual) Square Tube: 31.4 w x 31.4 h x 3.0 t 6,096.0 mm lengths

Utilization(%) 87.11

Unit Cost (USD / kg) 1.200

Titanium, Ti-5Al-2.5Sn	Grade 6 (annealed; ASTM B265,...	
Titanium, Ti-6Al-4V	Grade 5 (annealed; AMS 4928, A...	

**Material Stock**

Requested: Auto : <unknown>

Selected: Auto : Steel, HR, AISI 1010: (Virtual) Square Tube: 31.4 w x 31.4 h x 3.0 t 6,096.0 mm lengths

**Material Unit Cost**

## Cost by Category (%)

The Cost by Category (%) panel shows you at a high level where most of your costs are coming from. The Part Summary tab extracts various key values and calculates the percentage they represent of the **Fully Burdened Cost** for the part. Material, Labor, Overhead, Setup, and Investment all come from single values that can be viewed in the Part Details tab as shown below. Other is calculated by summing together multiple values: **Logistics, Other Direct, Margin, Period Indirect Overhead, and SG&A**. You can easily view the source for these percentages by holding your mouse over an entry to display a tooltip.

**Note:** Adding together the Labor, Overhead, and Setup percentages will tell you how much of the total cost is being spent on processes, the details of which can be viewed in the next panel (Cost by Process).

Part Summary		Cost Summary		Part Details		Investment				
Status	Name	Scenario	Material Unit Cost (USD / kg)	Utilization (%)	Parts Per Sheet	Utilization Mode	Material Cost (USD)	Labor (USD)	Direct Overhead (USD)	Amortized Batch Setup (USD)
● * Current		initial	2.535	59		Computed	1.22	3.01	1.15	0.05

**Cost by Category (%)**

- Material: 15.8
- Labor: 39.1
- Overhead: 14.9
- Setup: 0.6
- Investment: 0.9
- Other: 28.8

Logistics: 0.0  
 Other Direct: 7.6  
 Margin: 0.0  
 Period Overhead: 13.5  
 SG&A: 7.7

Part Summary		Cost Summary		Part Details		Investment	
Status	Name	Scenario	Fixture Cost (amortized) (USD)	Programming Cost (amortized) (USD)	Additional Amortized Investments (USD)	Total Amortized Investments (USD)	Fully Burdened Cost (USD)
● * Current		initial	<0.01	<0.01	0.00	0.07	7.71

Part Summary		Cost Summary		Part Details		Investment					
Status	Name	Scenario	Direct Overhead (USD)	Amortized Batch Setup (USD)	Logistics (USD)	Other Direct Costs (USD)	Total Variable Costs (USD)	Indirect Overhead (USD)	SG&A (USD)	SG&A Percent (%)	Margin (USD)
● * Current		initial	1.15	0.05	0.00	0.58	6.01	1.04	0.60	0.00	0.00

## Cost by Processes (%)

The Cost by Process (%) panel shows which process(es) are contributing the most to the cost of manufacturing the part. A process that seems excessively costly may be a candidate for further investigation and possibly a design improvement.

The percentage contribution of each process is calculated by comparing the sum of various process-related costs for that specific process, to the sum of these costs across all processes used in the routing. This sum is used rather than basing the percentage on Piece Cost or Fully Burdened Cost (FBC), because for some processes the Material cost is included in Piece Cost and FBC and would result in a skewed comparison. Therefore, the Cost by Process calculations assume no contributions from Material, Material Overhead, SG&A, or Margin.

The calculation is:

### Process:

(Labor Cost + Direct Overhead + Logistics + Amortized Batch Setup Costs + (Other Direct Costs - Material Overhead) + Indirect Overhead Costs + Fixed Costs) *for the process*

### Divided by:

*Sum of* (Labor Cost + Direct Overhead + Logistics + Amortized Batch Setup Costs + (Other Direct Costs - Material Overhead) + Indirect Overhead Costs + Fixed Costs) *for ALL processes*

Process	Percent Cost
Vertical Automatic	5.6
Shakeout	18.2
Cleaning	2.4
Finishing	10.7
InLine Inspection	1.8
5 Axis Mill	37.9

Calculation for the process

-----  
Calculation for ALL processes

Note that clicking the Process column heading will sort the table alphabetically and clicking the Percent Cost heading will sort the table numerically.

## Component Costs and Targets

The Component Costs and Targets panel provides a quick indication of how the part stands regarding cost and mass goals (allow for some rounding differences). Targets are typically set in the Cost Guide.

Part Summary		Cost Summary		Part Details		Investment			
Cost Object		Fully Burdened	Aggregate...	Unit Cost -...		Capital Costs		Cost Targets	
Status	Name	Fully Burdened Cost (USD)	Batch Cost (USD)	Unit Cost - PPC (USD)		Total Capital Investments (USD)	Target Cost (USD)	Variance From Target Cost (USD)	% Variance From Target Cost
● *	Current	▲ 7.71	▲ 35,649.39	▲ 7.64		▲ 19,119.22	4.00	▲ 3.71	▲ 93

Component Costs And Targets	
Fully Burdened Cost (USD)	7.71
Capital Investment (USD)	19,119.22
Target Cost (USD)	4.00
% Variance To Target Cost	92.70
Target Mass (kg)	0.30
% Variance To Target Mass	-5.60

Part Summary		Cost Summary		Part Details		Investment			
Cost Object						Mass Targets			
Status	Name	Scenario		Target Finish Mass (kg)	Variance From Target Finish Mass (kg)	% Variance From Target Finish Mass			
● *	Current	initial		0.30	-0.02	-6			

# Validation and Design to Cost

The **Validation** and **Design to Cost** tabs are intended for design engineers using the following process groups:

- **2-Model Machining**
- **Casting – Die**
- **Casting - Sand**
- **Plastic Molding**
- **Sheet Metal**
- **Stock Machining**

(But note that a basic **Validation** tab is available for other process groups—see [Prerequisites](#).) These tabs provide centralized information, functionality, and context-sensitive guidance to help you validate/modify assumptions made by aPriori, and then evaluate and address design details.

This is a self-documenting area of the UI: aPriori has brought together information and functionality from across the product and consolidated it with detailed in-UI explanations and suggestions intended to guide the design engineer in identifying and evaluating common areas for cost savings, and providing recommendations to make improvements in either aPriori or the CAD model.

This section walks you through the basic steps of how to use the **Validation** and **Design to Cost** tabs for Stock Machining. The same basic approach will be applicable to other Process Groups.

## Prerequisites

The **Validation** and **Design to Cost** tabs display information only if the current component has been costed in one of the supported Process Groups.

If you click on the **Validation** or **Design to Cost** tab while displaying an uninitialized (uncosted) component, aPriori displays the following error message:

```
"Please initialize the component by costing it."
```

If you click on the **Design to Cost** tab while displaying a component that has been costed in an unsupported Process Group, aPriori displays the following error message:

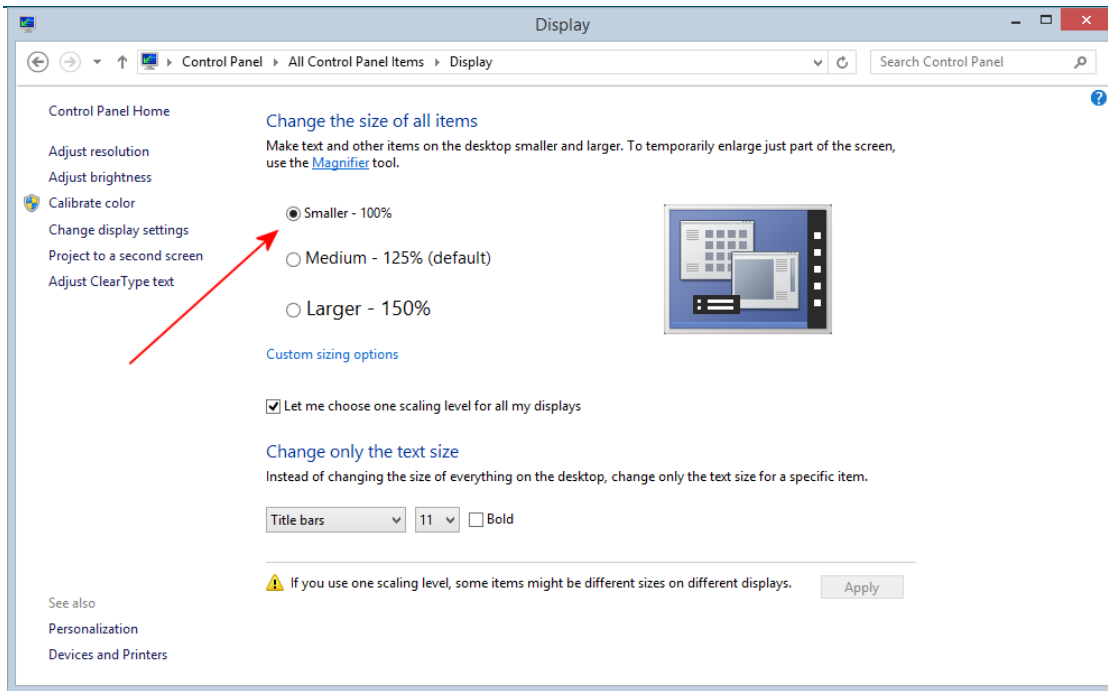
```
"A Design to Cost view is not yet available for this process group."
```

If you click on the **Validation** tab while displaying a component that has been costed in an unsupported Process Group, the displayed validation information is limited to information on uncosted GCDs: those that could not be recognized by geometry extraction and those that failed to meet the feasibility requirements for assignment to some operation sequence.

Use the **Cost Guide** to initialize the component with one of the supported Process Groups (if appropriate). See [Initial costing: The Cost Guide](#) for more information.

**Note:** The **Validation** and **Design to Cost** tabs work best when your Windows screen resolution is set to "100%" or "Smaller". The details for accessing this setting can vary between Windows versions, but in general it can be found in the "Display" window of the **Control Panel**:





## Workflow

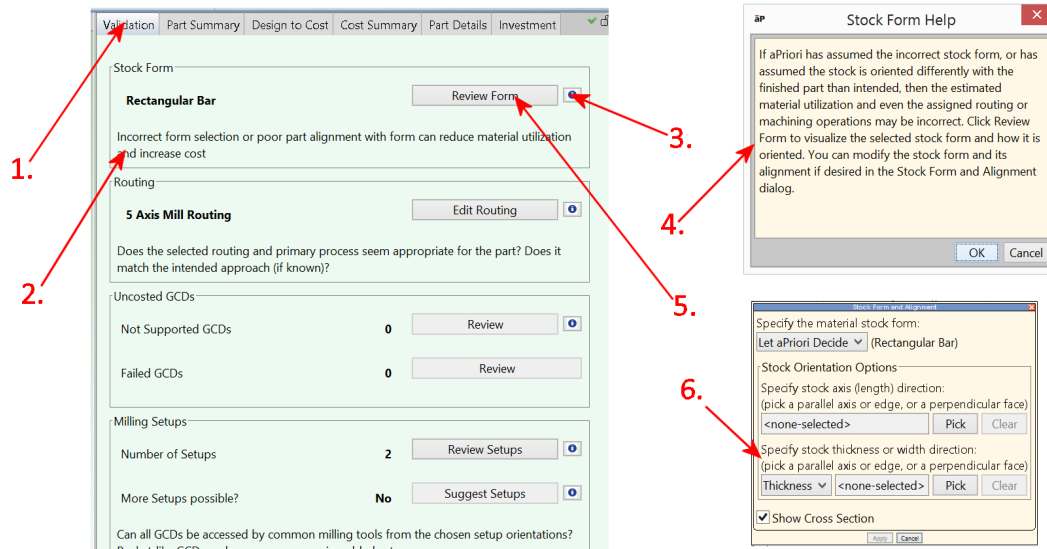
The **Validation** and **Design to Cost** tabs are designed for a very logical workflow: Start with the **Validation** tab so that you can understand and evaluate (and potentially adjust) some of the basic assumptions that aPriori has made when costing your part. You should also note if there are any Uncosted GCDs, so you can investigate this further. To investigate further, use the **Issues** pane on the **Design to Cost** tab or use the **Messages** pane to see how the GCD was processed. Then you can use the **Design to Cost** tab to understand and evaluate (and potentially adjust) the design-related cost driver details.


## Validation and Design to Cost: Stock Machining

The following sections describe the Stock Machining version of Validation and Design to Cost.

### To validate aPriori's assumptions about Stock Machining

Use the following illustration to step through the validation phase for Stock Machining.



- 1 Click the **Validation** tab.
- 2 Read the boxed information in the first panel to understand how aPriori's assumptions can affect your cost.
- 3 Click the **Information** Help button (  ) in the first panel.
- 4 Read the Help display for more detailed information on how this area can affect costs, and how best to proceed.
- 5 Click the provided button(s) to review and/or adjust aPriori's assumptions for this aspect of costing.
- 6 These buttons display various dialog boxes or editors for you to evaluate and adjust (if necessary) the settings that aPriori chose for this particular area of costing. When you click Apply or Ok for these windows, aPriori immediately recosts the component with your adjusted setting(s).
- 7 Repeat Steps 2 through 5 for each of the Validation panels that are relevant to your component.

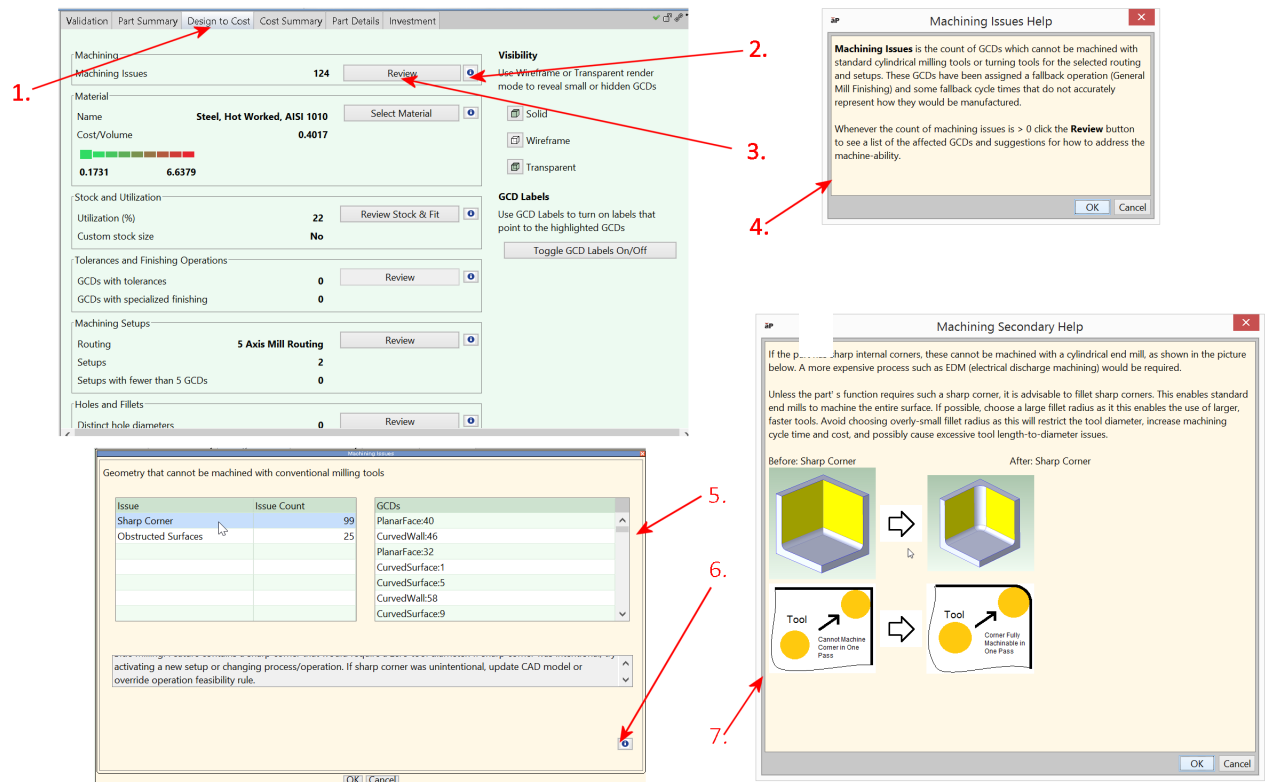
Once you have validated and adjusted these basic settings, you are positioned to evaluate and adjust design-related cost driver details using the **Design to Cost Information** tab.

### To use the Design to Cost tab for Stock Machining


The Design to Cost Information tab provides the designer with very specific cost driver details, and places at his or her fingertips both detailed context-sensitive help to understand the cost ramifications of these details, as well as the ability to evaluate and adjust these details. The workflow is similar to that of the Validation stage but goes into greater detail.

**Note:** Some panes may identify issues that could prevent the part from being manufactured, while others might identify costing considerations where the part could be redesigned to be manufactured more efficiently and less expensively. In most cases, aPriori does not identify problems that you must address; rather, it flags *potential* issues, or cost drivers that *might* be good candidates for evaluation and possible change.

Use the following illustration to step through the validation phase for Stock Machining.



1 Click the **Design to Cost** tab.

2 Click the **Information** Help button (  ) in the first panel.

3 Read the Help display to understand how this area can affect costs, and how best to proceed.

4 Click the provided button(s) to evaluate and adjust the settings for this area.

5 The dialogs and windows will vary depending on the cost drivers you are working with. Some may go down an additional level or two to provide the proper resolution and control of the displayed details. Read the information in each dialog for guidance about how to proceed. Some suggestions may direct you to aPriori settings, while others provide ideas that you may want to consider for incorporation in the CAD model itself.

Note that when you select items in these windows, the window often displays further context-sensitive guidance based on your selection and may also highlight relevant

geometry in the viewer and in the **Manufacturing Process** and **Geometric Cost Driver** panels.

- 6 Where provided, take advantage of additional **Information** Help buttons.
- 7 The additional help panels can provide very specific guidance regarding your current selection. These are often context-sensitive and will display different information depending on what you have selected.

Repeat Steps 2 through 7 for each of the panels that apply to your specific component.

## Notes and examples for Validation and Design to Cost

You may find the following examples helpful in demonstrating how to use the various panes and controls of the **Validation** and **Design to Cost** tabs. Since the tabs are designed to be self-guided, this section provides notes and examples that are specific to the Stock Machining process group, but the general usage patterns are similar for other process groups:

**Validation, Stock Form:** Say that aPriori chose Plate stock for your part, but you feel that Rectangular Bar might be a better option. This pane allows you to easily review the existing choice -- and then easily change that choice – without searching throughout the aPriori UI and system Help for the specific displays, settings, and guidance that you need.

**Validation, Routing:** Perhaps aPriori chose a 3-Axis Mill for machining your part, but you have access to a 4-Axis Mill and have reason to believe that this might be a better choice for this particular part. Clicking the **Edit** button in this pane brings up the **Routing Selection** window to allow you to easily evaluate your options and choose a different routing if you like.

**Validation, Milling & Turning Setups:** aPriori is relatively conservative about recommending setups – it tends to minimize the number of setups due to the cost of re-fixturing. The Setups sections allow you to easily review and edit the aPriori recommended setups. The Milling Setups sections also allows you to review additional possible setups that aPriori identified but did not choose.

**Note:** For 4-axis and 5-axis mill routings, you may see different axes referenced in different parts of the DTC user interface. For example, the **Validation** tab might list two axes (the active rotational axes), while the **Active Setup Axes** table in the **Modify Setup Axes** dialog box lists four axes, with two of them labeled “Unused”. This is because the dialog is displaying both the inactive primary and secondary principal (non-rotational) axes, as well as the active primary and secondary rotational axes. Inactive axes are labeled “(Unused)”. Both are displayed because the only way to specify which axes are rotational setups is by modifying the non-rotational setups.

**Design to Cost, Machining:** The **Machining** panel identifies issues that can actually prevent the part from being successfully manufactured and provides guidance on how to address such an issue. Select the issues and/or the related GCDs to highlight them in the viewer and the client UI. Take advantage of the detailed help provided by the Information icons to learn more about specific issues and the steps you can take to address them.

Note that some “Obstructed Surfaces” may be categorized as “Missing Setups” issues rather than “Obstructed Surfaces”. If the GCD could be machined from a setup which exists but is not active, it is considered "Missing Setup". However, if it is obstructed from ALL setups, it is considered “Obstructed”.

**Design to Cost, Material:** aPriori does not make a recommendation on whether or not you should change the selected material, it just simply identifies it to you as a major cost driver and gives you the tools you need to easily evaluate it and, if necessary, change it. Note that the gauge shows “Cost per Volume” rather than “Cost Per Mass” which makes it easier to compare materials of differing density.

**Design to Cost, Stock and Utilization:** aPriori cannot make a determination whether a stock utilization of (for example) "18%" is good or bad, but this panel allows you to consider whether you can adjust allowances to reduce the space between the part outline and the stock outline. Or perhaps you might consider dividing the part into two parts that are then joined together, to avoid generating a large amount of scrap. If you have a lot of space between the part outline and the stock outline, you can easily adjust allowances from here, rather than searching out and adjust specific Process Setup Options (PSOs). You can also select ANY stock in the VPE that is large enough to accommodate the part, which gives you more flexibility than provided by the standard Material Selection dialog where your choices are sometimes more limited.

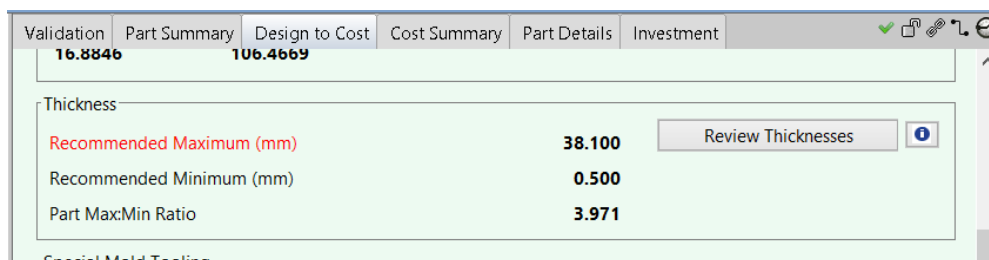
**Design to Cost, Tolerance & Finishing:** This display can be of some general interest, but the "Features with specialized finishing" list shows if those tolerances are driving special operations and are therefore significant cost drivers. If you can loosen up your tolerance to the "Best Achievable" value possible so that fewer GCDs require a special finishing operation, you can significantly reduce your cost.

**Design to Cost, Holes & Fillets:** Use this panel to identify if you can limit the number of different-sized holes and fillets in your part to reduce the number of tool changes required to manufacture it. Also evaluate whether your part uses standard sizes so that common (rather than specialized or custom) tools can be used.

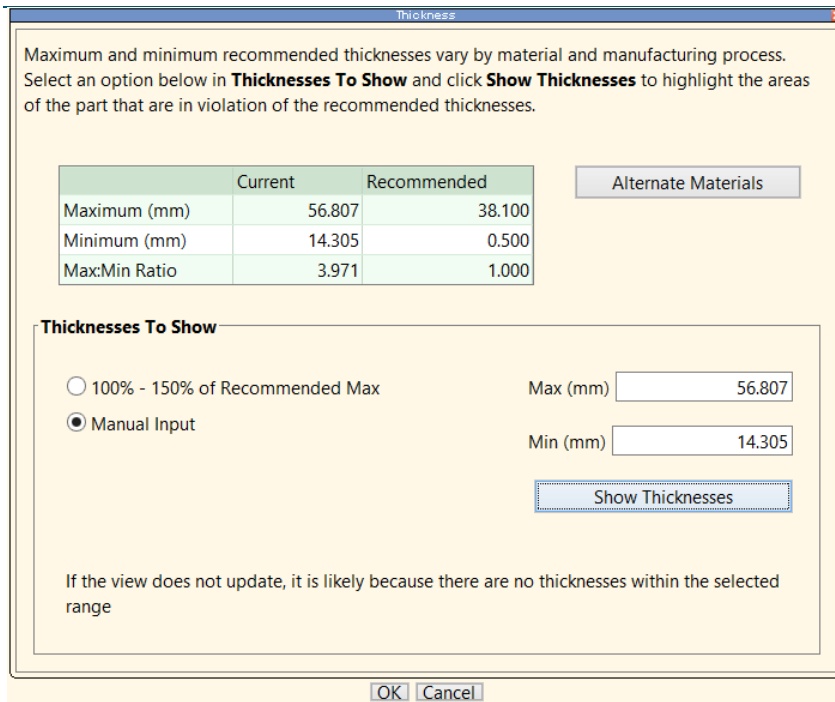
**Design to Cost, Slow Operations:** This panel identifies ball-end milling operations that are valid, but which take a long time to complete (and therefore drive up cost). Consider whether these operations could instead be performed by facing or side-milling operations, either through part design modifications or different setups.

## Thickness Violations in Casting and Plastic Molding Design to Cost

For the process groups Plastic Molding, Casting-Die, and Casting-Sand, the Thickness panel of the Design to Cost tab displays Recommended Maximum and Recommended Minimum thickness values for the selected part material. These fields are displayed in red if the recommended thresholds are violated. The tab also displays the ratio of the part's maximum thickness to its minimum thickness. A ratio near 1, that is, near-uniform thickness, is recommended.

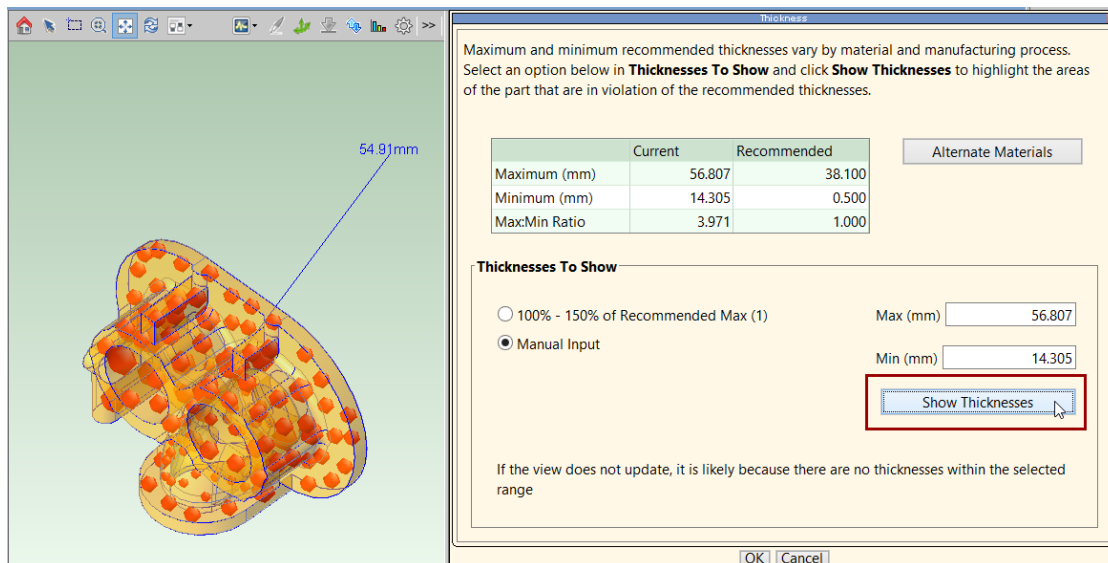


Click the **Review Thickness** button to display the Thickness dialog.



Click **Alternate Materials** to see the recommended thickness thresholds for all materials.

Click **Show Thickness** to display thickness violations in the Viewer. Violations are displayed as red spheres. A label is displayed that points to the location of minimum thickness.



To modify the maximum and minimum thickness thresholds, click the **Manual Input** radio button and enter values into the **Max** and **Min** fields. Then click **Show Thickness** to display thickness violations in the Viewer using the modified thresholds.

You can also display thicknesses that are in a specified range. Click one of the following radio buttons (some or all of them appear in the dialog), and then click **Show Thickness**:

- **> 150% of Recommended Max**: click this radio button, and then click **Show Thickness** to display thicknesses that are greater than 150% of the recommended maximum. A label is displayed that points to the location of maximum thickness.

- **100%-150% of Recommended Max:** click this radio button, and then click **Show Thickness** to display thicknesses that are between 100% and 150% of the recommended maximum. A label is displayed that points to the location of maximum thickness.
- **100%-50% of Recommended Min:** click this radio button, and then click **Show Thickness** to display thicknesses that are between 100% and 50% of the recommended minimum. A label is displayed that points to the location of minimum thickness.
- **< 50% of Recommended Min:** click this radio button, and then click **Show Thickness** to display thicknesses that are less than 50% of the recommended minimum. A label is displayed that points to the location of minimum thickness.

## Cost Summary

The **Cost Summary** tab displays detailed costing information for a part or an assembly. It provides Current, Previous, and Last Saved information. The **Cost Summary** tab includes:

Cost type	Cost name	Description
Variable Costs	Material	The cost of the material used to manufacture the part. Includes allocation of scrap material wasted during manufacturing. Does not include consumable material, such as weld wire or adhesives, only primary material.
	Labor	The cost of labor needed to manufacture the part or assembly. Usually includes hourly wages and benefits.
	Direct Overhead	Costs associated with machine operation, such as the machine's power costs, depreciation, or maintenance, based on time.
	Batch Setup (amortized)	The cost configuring a machine to run a batch of a given design (accounts for machine downtime and labor incurred). The cost is amortized to individual parts or assemblies by dividing by the number of components in a batch.
	Logistics	The cost of transportation between supply chain facilities.
	Material Overhead	Overhead costs associated with the purchase and storage of material, as well as with moving material to the work center.
	Expendable Tooling	The cost of tooling, such as a drill bit or turret press punch, consumed during manufacturing of many different parts.
	Additional Direct Costs	Other miscellaneous costs not accounted for in above categories. The default value is zero.
	Extra Costs	A "placeholder" line item to be used for miscellaneous costs. The default value is zero but your VPE may be customized to use this field to capture specific types of costs and relabeled as needed (see the aPriori Administration Guide, Managing Cost Taxonomy Display Labels).
	Other Direct Costs	The subtotal of Expendable Tooling, Additional Direct Costs, and Extra Costs.
Total Variable Costs	The sum of all cost items above, Total Variable Costs is the marginal cost associated with making "one more" part of a give design. This includes all Variable Costs associated with the creation of a part but does not include depreciation of capital tooling.	



Cost type	Cost name	Description
Period Costs	Period Overhead Allocations	Period or indirect overheads are expenses that are expensed each financial period (factory depreciation, light bills, SG&A) that cannot be associated or amortized to a specific design.
Margin	Margin	The profit margin charged on each part/assembly. Calculated by multiplying a margin percentage value by the sum of the above costs. The margin percentage defaults to 0 in the Regional Data Libraries but can be configured by customers.
Piece Part Cost	Piece Part Cost	The sum of all cost items above, Piece Part Cost is cost of making a part, including margin if applied but excluding Fixed (tooling-related) Costs.
Fixed Costs	Hard Tooling (amortized)	The cost of capital or hard tools that are needed to manufacture one specific design and cannot be used to create other designs.
	Fixture Cost (amortized)	The cost of devices that hold a specific part or assembly in the correct orientation on a machine during manufacture or assembly. These devices are not supposed to be re-used for a part or an assembly of a different design.
	Programming Cost (amortized)	The cost of creating a computer program that Computer Numerical Control (CNC) machines will follow to make or assemble parts of a specific design.
	Additional Amortized Investments	Other miscellaneous costs not accounted for in the above categories.
	Total Amortized Investments	The sum of all fixed costs. Fixed costs must be incurred before the start of manufacturing. In aPriori, all fixed costs are amortized to the individual part or assembly by dividing the total, up-front cost for the fixed cost (the capital cost) by the Total Product Volume.
	Fully Burdened Cost of Assembly Processes	The sum of Piece Part Cost and Fixed Costs for the Assembly Processes. This cost applies only to assemblies.
	Fully Burdened Cost of Subcomponents	This is the total of the Fully Burdened Costs for all the first level children (parts and assemblies) of the top-level assembly or roll-up. This cost applies only to assemblies.
	Fully Burdened Cost	For parts, the sum of Piece Part Cost and Fixed Costs. For assemblies, the sum of Fully Burdened Cost of Assembly Processes and Fully Burdened Cost of Subcomponents. For Roll-ups, the sum of Piece Part Cost and Fixed

Cost type	Cost name	Description
		Costs for all first level children (parts, assemblies, roll-ups). (See <i>A note about Fully Burdened Cost</i> ).
Capital Costs	Hard Tooling	Capital or hard tools are purchased for creating one specific design and cannot be used to create others. The Capital Cost is the price to buy one set of the tooling.
	Fixture Cost	The cost of devices that hold a specific part or assembly in the correct orientation on a machine during manufacture or assembly. These devices are not supposed to be re-used for a part or an assembly of a different design. The capital cost is the price to buy one set of the tooling.
	Programming Cost	The cost of creating a computer program that Computer Numerical Control (CNC) machines will follow to make or assemble parts of a specific design.
	Total Capital Investments	Capital investment is the total amount a company must invest in fixed costs before the first part or assembly can be made. This cost is 'fixed' because the company incurs the cost whether it makes one part or the total number of parts allowable before tooling must be refurbished or replaced.

## Part Details and Assembly Details

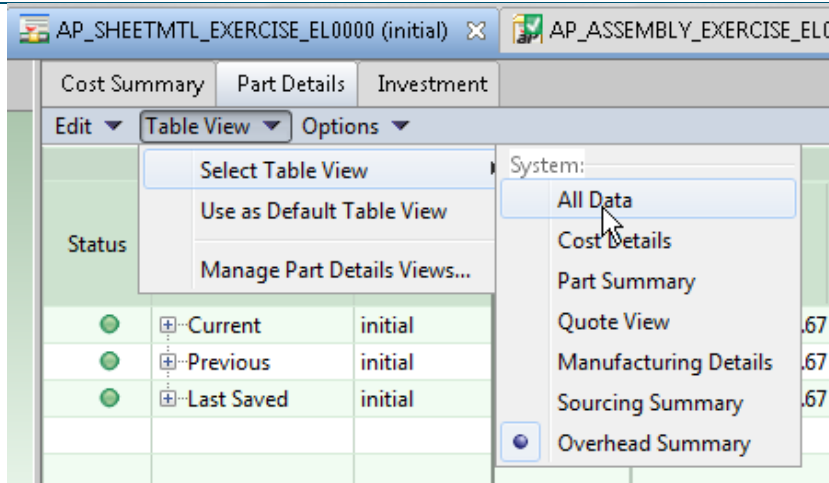
The Part Details and Assembly Details tabs display a wealth of detailed information about the part or assembly, respectively, and its cost (for a given Virtual Production Environment (VPE) and process routing). Various categories of information can be configured into different views or sets of information. These categories include descriptive information; current cost and quote data; production information; VPE, process, and machine information; manufacturing times and costs, as well as input rates (such as hourly labor and overhead rates and material unit costs) used in the cost computations. The Part Details and Assembly Details views provide Current, Previous, and Last Saved information.

**Note:** In the Assembly Details table for an assembly, you can open an assembly component by double-clicking on the row in the table.

Some of the fields presented in these views are editable. See *Overriding computed values* for more information.

The Assembly Details tab includes four pre-defined views which provide different sets of fields, for different purposes. These pre-defined views include the Assembly Summary view, the Assembly Cost Detail view, the Sourcing Summary view, and the Assembly Process Detail view. These views are described later in this chapter.

Both the Part Details and Assembly Details tab provide a number of pre-defined views that you can display by clicking **Table View ->Select Table View**:



These pre-defined views help you focus the data display on a specific area of interest such as the Overhead Summary (which was added to support the direct and indirect overhead enhancements introduced in release 2015 R1). aPriori also provides an **All Data** view, which provides a superset of all data fields available for the part, grouped into categories. The All Data view provides a useful starting point for the creation of new customized views. For more information, see *Creating new views on page 277*.

The Part Details and Assembly Details tables include the following fields and more:

Cost drivers		Description
Process	Process	The cost associated with a particular type of manufacturing process that a machine performs.
	Machine Name	The machine used by the cost engine to compute costs for the given process.
	Labor Time (s)	The time that someone is paid to perform an operation/process on one part/assembly.
Manufacturing Times	Cycle Time (s)	The actual time that a machine/process is operating on a given part/assembly.
	Parts Per Hour	Computed as 3600 seconds per hour divided by Cycle Time.
Variable Costs	Material Cost	Cost of the physical material used in the manufacture of the part. Material Cost includes both the material in the physical part and an allocation of scrap material that is wasted during the manufacturing process. Material cost does not include consumable material (for example, weld wire, adhesives, etc.), only primary material.
	Labor	The amount that labor is paid to manufacture the part or assembly. The customer determines which components of labor compensation are included in the labor rate that is used to calculate labor cost. However, labor cost usually includes hourly wages and benefits.

Cost drivers		Description
	Direct Overhead	Direct Overhead costs are costs that can be specifically associated with the manufacture of specific part through a machine. For example, most machines have a machine or direct overhead rate that allocates the machine's power costs, depreciation, maintenance, etc. to parts that run on the machine based on time.
	Batch Setup (amortized)	The cost in machine downtime and labor incurred when a machine is configured to run a batch of a given design. This cost is amortized to individual parts or assemblies by the number of parts in a batch.
	Logistics	The cost of transportation between supply chain facilities.
	Expendable Tooling	Tooling that is consumed during manufacturing, but not tied to a specific part. For example, a drill bit, turret press punch, etc. are used in the manufacture on many different part designs.
	Additional Direct Costs	Other miscellaneous costs not accounted for in the above categories.
	Extra Costs	A placeholder line item to be used for miscellaneous costs. The default value is zero but your VPE may be customized to use this field to capture specific types of costs and relabeled as needed (see the aPriori Administration Guide, Managing Cost Taxonomy Display Labels).
	Other Direct Costs	The subtotal of Expendable Tooling, Additional Direct Costs, and Extra Costs
	Total Variable Costs	The sum of all cost items above, Total Variable Costs is the marginal cost associated with making "one more" part of a give design. This includes all Variable Costs associated with the creation of a part but does not include depreciation of capital tooling.
Period Costs	Period Overhead Allocations	Period or indirect overheads are expenses that are expensed each financial period (factory depreciation, light bills, SG&A) that cannot be associated or amortized to a specific design.
Margin	Margin	The profit margin charged on each part/assembly. Calculated by multiplying a margin percentage value by the sum of the above costs. The margin percentage defaults to 0 in the Regional Data Libraries but can be configured by customers.
Piece Part Cost	Piece Part Cost	The sum of all cost items above, Piece Part Cost is cost of making a part, including margin if applied but excluding Fixed (tooling-related) Costs.

Cost drivers		Description
Fixed Costs	Hard Tooling (amortized)	Capital or hard tools are purchased for creating one specific design and cannot be used to create others.
	Fixture Cost (amortized)	Devices used to hold a specific part or assembly in the correct orientation on a machine during manufacture or assembly. Fixtures and jigs under the Fixed Cost category are created for a specific design. It is assumed that these fixtures will not be re-used on a different design in the future.
	Programming Cost (amortized)	The cost of creating a computer program that Computer Numerical Control (CNC) machines will follow to make or assemble parts of a specific design.
	Additional Amortized Investments	Other miscellaneous costs not accounted for in the above categories.
	Total Amortized Investments	The sum of all fixed costs. Fixed costs must be incurred before the first part or assembly of a given assembly can be made. In aPriori, all fixed costs are amortized to the individual part or assembly by dividing the total, up-front cost for the fixed cost (the capital cost) by the Total Product Volume.
Fully Burdened Cost	Fully Burdened Cost	For parts, the sum of Piece Part Cost and Fixed Costs. For assemblies, the sum of Fully Burdened Cost of Assembly Processes and Fully Burdened Cost of Subcomponents. For Roll-ups, the sum of Piece Part Cost and Fixed Costs for all first level children (parts, assemblies, roll-ups). <i>(See A note about Fully Burdened Cost.)</i>
Unit Cost	Unit Cost	For assemblies, the unit cost is the cost of one part, regardless of the quantity of parts in the assembly.
Capital	Hard Tooling	Capital or hard tools are purchased for creating one specific design and cannot be used to create others. The Capital Cost is the price to buy one set of the tooling.
	Fixture Cost	Devices used to hold a specific part or assembly in the correct orientation on a machine during manufacture or assembly. Fixtures and jigs under the Fixed Cost category are created for a specific design. It is assumed that these fixtures will not be re-used on a different design in the future. The capital cost is the price to buy one set of the tooling.
	Programming Cost	The cost of creating a computer program that Computer Numerical Control (CNC) machines will follow to make or assemble parts of a specific design.

Cost drivers		Description
	Total Capital Investment	Capital investment is the total amount a company must invest in fixed costs before the first part or assembly can be made. This cost is fixed because the company incurs the cost whether it makes one part or the total number of parts allowable before tooling must be refurbished or replaced.

## Investment

The Investment table displays information about the processes, tool types, and tool categories for a part. It provides Current, Previous, and Last Saved information.

Name	Tool Name	Type Name	Value	Unit
<b>Current:</b>				
<b>TOTAL (Hard Tooling)</b>	-	-	<b>20,174.90</b>	<b>USD</b>
Hammer	Additional Blocking Cavity Cost	Hard Tooling	2,116.50	USD
Hammer	Base Hammer Die Cost	Hard Tooling	12,038.93	USD
Press	Pierce Die Cost	Hard Tooling	4,221.94	USD
Trim	Trim Die Cost	Hard Tooling	1,797.53	USD
<b>Previous:</b>				
<b>TOTAL (Hard Tooling)</b>	-	-	<b>17,056.48</b>	<b>USD</b>
<No tooling info>	-	-	-	-
<b>Last Saved:</b>				
<b>TOTAL (Hard Tooling)</b>	-	-	<b>17,056.48</b>	<b>USD</b>
<No tooling info>	-	-	-	-

The Investment table includes:

Column Heading	Description
Name	The manufacturing process.
Tool Name	The general type of tool that is being costed (for example, Blanking Die, Cam-actuated Die, etc.).
Type Name	The category of tooling the tool falls under. That is, Hard Tooling (Capital Tooling treated as a fixed cost) or Expendable Tooling (treated as a direct variable cost).
Value	Total capital investment.
Unit	Currency setting.

## Assembly tracker

The Assembly Tracker tab graphically displays a summary of cost information for an assembly, using pie charts, bar charts, and gauges. The Assembly Tracker charts include:

- **Summary of Assembly Costs** - a pie chart that breaks down total assembly costs into assembly process costs (the costs of assembly subcomponents) and the costs of manufacturing those subcomponents themselves.
- **Summary of Component Costs** - a pie chart that decomposes the cost of the subcomponents into constituent costs (Material Cost and Labor & Direct Overhead costs)
- **Status of Component Costs** - a bar chart that displays the percentage of subcomponents that have been costed (useful for identifying if any subcomponents were not previously costed and therefore appropriate costs are not rolling up into the assembly costs).
- **Type of Costs** - a bar chart that displays the percentage of subcomponents with a given type of cost (as specified in the **Administrative Info** tab of the **Cost Object** window for the subcomponent)
- **Manufacturing Locations (VPE)** - a bar chart that displays the various VPEs used in costing the assembly process and the assembly subcomponents, and the percentage of subcomponents costed at each VPE.
- **Comparison of Alternatives** - a bar chart that compares the Current assembly cost to the Previous cost and the Last Saved cost, and breaks down each cost into some significant component costs (Material, Labor & Direct Overhead, Amortized Batch Setup)
- **Finish Mass Target Analysis** - a gauge which compares the actual finish mass of the assembly and its subcomponents to the mass targets specified and computes the variance.
- **Cost Target Analysis** - a gauge which compares the actual cost of the assembly and its subcomponents to the cost targets specified and computes the variance.

## Assembly process detail

The Assembly Process Detail view displays detailed process information about an assembly, as well as Current, Previous, and Last Saved information. The Assembly Process Detail view is one of the predefined views available on the Assembly Details tab.

### To select the Assembly Process Detail view

- 1 Click on the Assembly Details tab.
- 2 Click on the Table View menu, and then click on the Select Table View menu item.
- 3 Click on Assembly Process Detail menu item. The Assembly Process Detail view will be displayed.

The Assembly Process Detail view includes the following fields (depending on which manufacturing processes are used or relevant):

Cost type	Cost name	Description
Total Times and Costs	Total Labor Time (secs)	The time that someone is paid to perform an operation/process on one part/assembly.
	Total Cycle Time (secs)	The actual time that a machine/process is operating on a given part/assembly.
	Manual Cycle Time (secs)	The time for a person to perform all tasks to weld one assembly (loading, clamping, arcing, etc.).
	Robot Cycle Time (secs)	The time for a robot and its operator to perform all tasks to weld one assembly (loading, clamping, arcing, etc.).
	Total Labor Cost	The amount that labor is paid to complete the assembly task. The customer determines which components of labor compensation are included in the labor rate that is used to calculate labor cost. However, labor cost usually includes hourly wages and benefits.
Fixture Loading	Load Time (secs)	The time that operator(s) are paid to load parts into the welding fixture.
	Clamp Time (secs)	The time that operator(s) are paid to clamp the parts down in the welding fixture.
	Unload Time (secs)	The time that operator(s) are paid to unload the welded assembly from the fixture.
	Labor Time (secs)	The total time that operator(s) are paid to perform the fixture load, clamp, and unload operations.
	Cycle Time (secs)	The actual time to perform all the tasks to load, clamp, and unload the fixture.
	Labor Cost	The amount that labor is paid to load, clamp, and unload the fixture. The customer determines which components of labor compensation are included in the labor rate that is used to calculate labor cost. However, labor cost usually includes hourly wages and benefits.
Manual MIG Welding	Gun Manipulation Time (secs)	The time for a person to manipulate the MIG welding gun between the welds.
	Gun Manipulation Cost	The cost associated with manipulating the MIG welding gun between the welds.
	Gun Clean Time (secs)	The time for a person to clean the nozzle of the MIG welding torch/gun.



Cost type	Cost name	Description
	Arc Time (secs)	The time for a person to perform only the manual arcing to MIG weld one assembly (includes any manual tacking operations).
	Arc Cost	The cost associated for a person(s) to perform only the arcing to MIG weld one assembly.
	Labor Time (secs)	The total time that operator(s) are paid to perform the welding operation (that is, gun manipulation, gun cleaning, and arcing).
	Cycle Time (secs)	The actual time for all the welding tasks on one assembly (gun manipulation, gun cleaning, and arcing).
	Labor Cost	The amount that labor is paid to perform the welding task (that is, gun manipulation, cleaning, and arcing).
Robot MIG Welding	Gun Manipulation Time (secs)	The time for a robot to manipulate the MIG welding torch/gun.
	Gun Clean Time	The time for the robot system to clean the nozzle of the MIG welding torch/gun.
	Arc Time (secs)	The time for a robot to perform only the arcing to MIG weld one assembly.
	Arc Cost	The time for a robot to perform only the arcing to MIG weld one assembly.
	Labor Time (secs)	Any operator time required to support the robot welding operation.
	Cycle Time (secs)	The time for a robot and its operator to perform all the welding tasks for one assembly (that is, gun manipulation, cleaning, and arcing).
	Labor Cost	Any labor time that is paid to perform the robot welding task (that is, gun manipulation, cleaning, and arcing).
Manual SPOT Welding	Gun Manipulation Time (secs)	The time for a person to manipulate the spot-welding torch/gun.
	Gun Manipulation Cost	The cost associated with manipulating the spot-welding torch/gun.
	Weld Time (secs)	The time for a person to perform only the arcing to spot weld one assembly.
	Weld Cost	The cost associated for a person to perform only the arcing to spot weld one assembly.


Cost type	Cost name	Description
	Labor Time (secs)	The total time that operator(s) are paid to perform the welding operation (that is, gun manipulation, gun cleaning, and arcing).
	Cycle Time (secs)	The actual time for all the welding tasks on one assembly (that is, gun manipulation, gun cleaning, and arcing).
	Labor Cost	The amount that labor is paid to perform the welding task (that is, gun manipulation, cleaning, and arcing).
Robot SPOT Welding	Gun Manipulation Time (secs)	The time for a robot to manipulate the spot-welding torch/gun.
	Weld Time (secs)	The time for a robot to perform only the arcing to spot weld one assembly.
	Weld Cost	The cost associated for a robot to perform only the arcing to spot weld one assembly.
	Labor Time (secs)	Any operator time required to support the welding operation.
	Cycle Time (secs)	The time for a robot and its operators to perform all the welding tasks for one assembly (that is, gun manipulation, cleaning, and arcing).
	Labor Cost	Any labor time that is paid to perform the robot welding task (that is, gun manipulation, cleaning, and arcing).
3 Axis Mill	Labor Time	Labor time for any machining operations on the assembly
	Labor	Labor cost
	Cycle Time	Cycle time for any machining operations on the assembly
	Material	Material Cost
	Direct Overhead	Direct overhead cost for assembly machining
	Expendable Tooling	Cost of exp. tooling based on production volume & life
	Logistics	Any manually entered logistics costs
	Setups (amortized)	Setup costs
	Add Direct Costs	Any manually entered additional direct costs

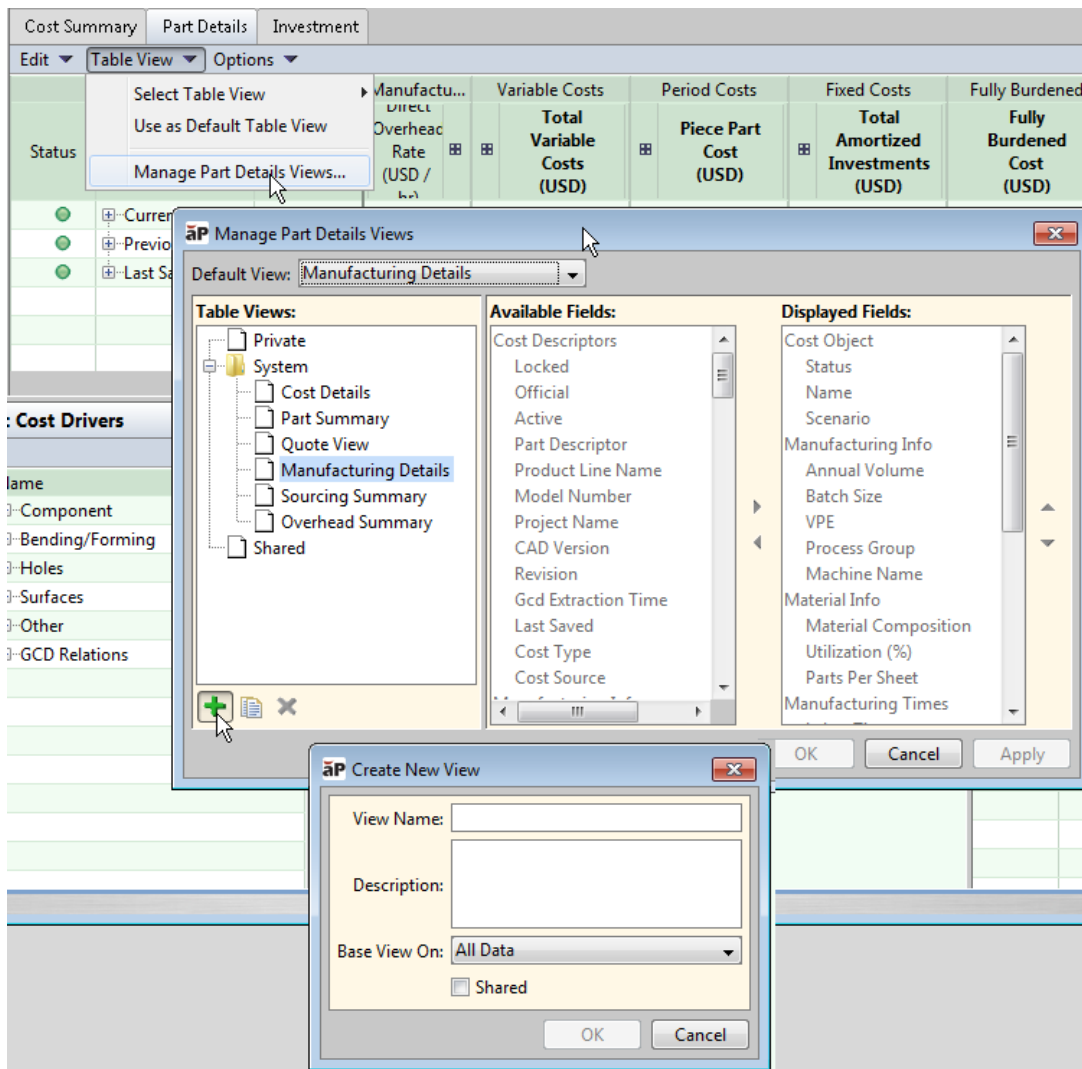
# Creating new views

The Part Details and Assembly Details tabs display descriptive, manufacturing and costing information about parts and assemblies, respectively.

Users can also create additional views, containing just the data fields of interest for a particular purpose, organized in a desired order. These views can then be selected to be displayed on the Part Details and Assembly Details tabs.

## To create a new view

- 1 From the **Part Details** or **Assembly Details** tab, click **Table View -> Manage Part (or Assembly) Details Views**. From the resulting **Manage...Details Views** window, click the "plus sign" **Add** icon (  ).



- 2 In the **Create New View** window, enter a View Name and Description, then use the **Base View On** drop-down menu to indicate which pre-configured view to use as a starting point (All Data is the default, since it contains all available fields).

- 3 Check the **Shared** checkbox if you want the new view you create to be available to other users. If you want the view to be Private (available only to yourself), leave the box unchecked.  
  
**Note:** A shared view can be deleted by any user who shares it. To ensure that a view that you want to keep is not inadvertently deleted, first create a private view. Then duplicate it and check the 'Shared' box. This creates a copy of the view so that it is always available in your private list even if someone else deletes the shared view.
- 4 Click OK. The **Customize Part/Assembly Details View** window will update to show the name of the new view you are creating, and whether it is a Private or Shared view.
- 5 The right panel of the window shows a list of **Available Fields** and **Displayed Fields**. Click the right arrow to move fields from the **Available** list to the **Displayed** list (use the left arrow to remove fields from the **Displayed** list). You can hold down the **Ctrl** key to move multiple fields at once. Use the up and down arrows to order the **Displayed Fields** as desired.
- 6 Click **OK** when you are satisfied with the contents and order of the new view.
- 7 To display the new view you have just created, click on the tab's **Table View** menu, then click the **Select Table View** menu item. A popup list of available views will appear. Select the view you just defined.
- 8 If you wish to edit the view further, once again choose **Manage Part/Assembly Details Views**. In the left panel, click on the view you just created (or any other view you wish to edit). The right-hand panel will update to show the configuration of the selected view, and you may reselect and reorder displayed fields as needed.

## Changing the Number of Decimal Places

By default, aPriori displays two significant digits after the decimal point. in various views including:

Cost Summary tab

Part Details and Assembly Details tab

Investment tab

Rollup Summary and Comparison Summary views

You can specify that more decimal places should be displayed in these views by adding the following line:

```
cost.table.decimal.places = <n>
```

to the following file:

```
C:\Users\<user>\AppData\Local\APriori\<version>\apriori.user.properties
```

where:

<n> is the number of significant digits to display

<user> is the Windows username of the current user

---

<version> is the aPriori version number

**Note:** Certain dialogs will NOT be affected by this option and will always be displayed with two decimal places. This includes the Cost Ticker, the Materials Selection dialog, and PDF reports.



# 10 Bulk Costing and Analysis

This section describes the Bulk Costing and Analysis module. This module is licensed separately.

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This chapter includes the following topics:

- Overview
  - User inputs files
  - Bulk costing groups of parts
  - Bulk costing part scenarios and assemblies
  - Bulk costing data fields
  - Editing bulk costing inputs
  - Costing a bulk cost group
  - Costing without a CAD file
  - Reviewing bulk costing and analysis results
  - Running from the Command Line
  - bulkLoad.cmd
  - bulkLoad.properties file
  - plugin.properties file
  - Running as a Scheduled Task
  - Bulk Costing Usage Reports (System Admins)
  - Understanding cost failures during bulk costing
-

## Overview

The separately-licensed Bulk Costing and Analysis module enables you to generate costs for multiple parts at the same time, and then analyze groups of parts to identify outliers for cost reduction opportunities.

A sub-set of features is also available in the main aPriori user interface without a separate license, for costing components with multiple scenarios, and for assemblies with multiple subcomponents and scenarios.

Bulk costing allows you to specify different scenarios so that you can compare the costs, for example, of producing parts in different areas of the world, or at different volumes. After an initial costing, subsequent re-costings do not require that GCDs be re-imported from CAD parts.

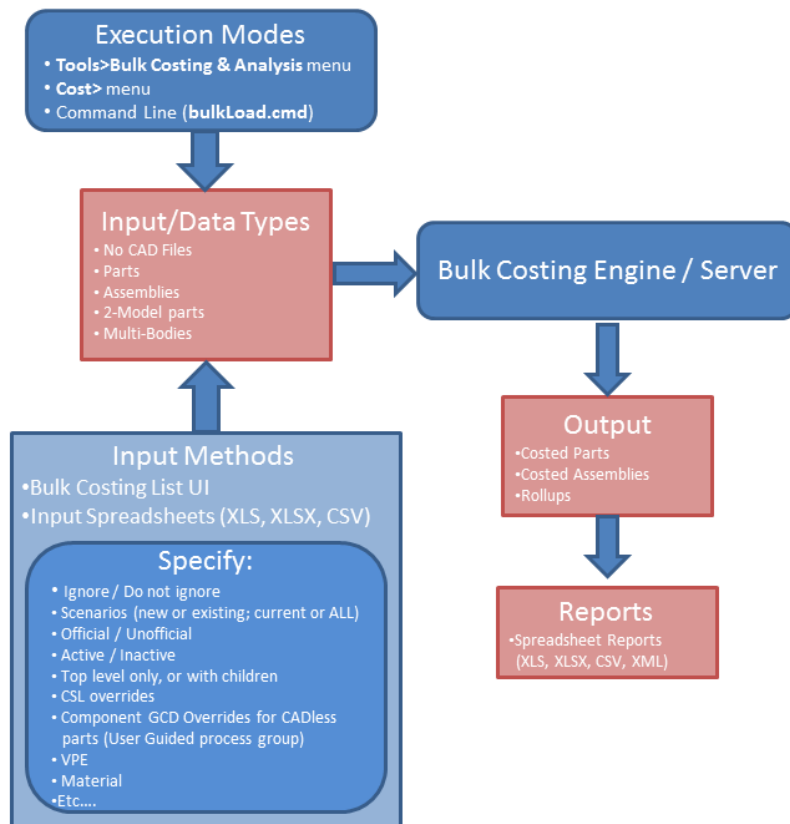
You can access Bulk Costing in a variety of ways:

- From the **Tools>Bulk Costing & Analysis** menu, for costing arbitrary groups of parts, optionally including CSV or Excel input sheets for further input.

From the command line, using CSV or Excel input sheets for input.

From the **Cost** menu, to cost parts and assemblies with multiple scenarios. (The **Cost** menu does not require a separate license).

The module allows you to quickly generate preliminary costs for groups of parts in bulk by setting their initial costing parameters using a tabular interface and then batch costing them.



Note that when you perform a bulk costing, aPriori will check all of the sub-components to see if any are open in the main UI with unsaved changes. If so, aPriori will prompt whether you want to save and close that component, leave it unsaved, or cancel the deep cost operation. It is important to realize that regardless of what you choose, the results of the deep cost will be determined by the inputs on the Bulk Costing and Analysis table, or any user inputs file, not by the changes to the sub-component in the UI.

## User inputs files

Bulk costing accepts an optional user inputs file in either Excel or CSV (comma-separated values) format files. This allows you to specify parts, production information, overrides for CSL values, and other cost inputs from a spreadsheet.

Production input values provided in this file take precedence over values from other sources. See [Precedence of production input overrides](#) for more information.

**Note:** aPriori strongly advises against manually creating input columns. Instead, generate the input spreadsheet as described in this section.

One way to get started with an inputs file is to create a new bulk cost group, edit its values in the Bulk Costing & Analysis UI, and then save the data with **File > Export User Inputs Spreadsheet**. This will create a user inputs file in Excel spreadsheet format. If you wish to create a CSV file, you can **Save As .csv** from Excel.

The columns in the spreadsheet files map to the columns in the Bulk Costing & Analysis UI in a fairly obvious manner.

Some of the less obvious mappings are covered in the following sections.

### Process Setup Option columns

Process Setup Option columns must be named in the form "<Process Name>:<Option Name>" and are case-sensitive. The available options vary from cost model to cost model, the following table lists some common process setup options and are intended as examples only.

Note that you can optionally add "mode name" in the column heading by using the "#" character:

<Process Name>:<Option Name>#<Mode Name>

The default value of mode name is "user".

Option Name	Purpose	Example column heading
includeOptionalRouting	Selects an optional process	Wet Coat Line:includeOptionalRouting
machine	Selects the machine for a specific process	3 Axis Mill:machine
vpe	Selects an XPG VPE	Surface Treatment:vpe



## CSL Formula Override columns (non-custom processes only)

Like Process Setup Option columns, CSL Formula Override column names begin with *<Process Name>:*.

The heading has the format of "*<Process Name>:override.<Formula Name>*". The data type of override values should be Double.

**Note:** CSL overrides in bulk costing are subject to the same limitations as in the main aPriori UI. See *Overriding computed values* on page 112.

## Custom (User defined) Attribute columns

Any columns with column headers start with "customAttributes."

## Pinned Routings

As of Release 2018 R1, you can now specify a desired Bulk Costing routing via the User Inputs spreadsheet. Previously, this “pinning” capability was available only through the **Routing Selection** dialog and the interactive Bulk Costing user interface. This enhancement makes it more efficient and less error-prone to perform bulk costing of many scenarios with known routings, as well as to perform cost model validation and calibration, since it is possible to save all costing inputs in an User Inputs spreadsheet for repeated costings. It also enables companies to more easily include routing data received from other enterprise systems.

The spreadsheet column for this feature is **pinnedRouting**. Also, for Release 2018 R1, users can have aPriori skip all feasibility checks by providing the value TRUE in a new **ignoreAllProcessFeasibility** column.

X	Y	Z	AA	AB
<u>pinnedRouting</u>	<u>sourceModel</u>	<u>sourceModel</u> <u>Scenario</u>	<u>ignoreAllProcessFeasibility</u>	
VerticalAutomatic			TRUE	

The **pinnedRouting** column accepts a comma separated list of process(es) and/or node(s) that specify a *non-ambiguous* routing, such as “VerticalAutomatic, 3 Axis Mill” in the Casting – Sand process group. The column is case-sensitive.

**Note:** “Non-ambiguous” does not mean “unique”. A pinned routing string is considered *ambiguous* and will be rejected if it matches a *disjoint* set of routings. In other words, aPriori allows anything that you can achieve via the Routing Selection view, where you can pin a single routing or group of routings, including all down-stream alternatives, but does not permit multi-selections.

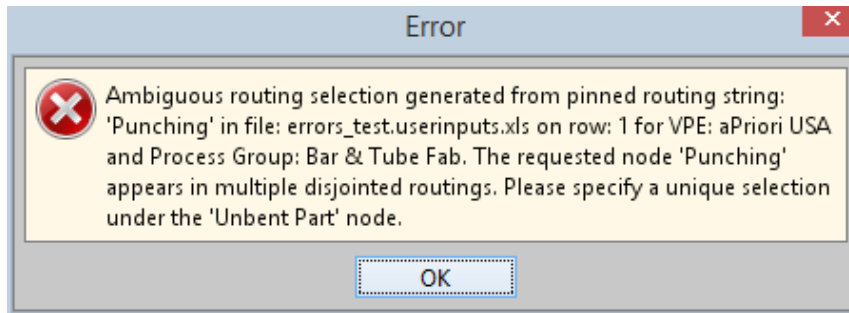
If you specify only “VerticalAutomatic” in the **pinnedRouting** column, aPriori will evaluate only the VerticalAutomatic routing branch in Casting – Sand, but it will evaluate all possible secondary machining routings for that scenario.

If you specify “VerticalAutomatic, 3 Axis Mill”, only the 3 Axis Mill secondary routing for VerticalAutomatic will be evaluated.

If you enter “aPriori” in the pinnedRouting column, then any previously pinned routings for the specified process group will be un-pinned and all possible routings will be evaluated.

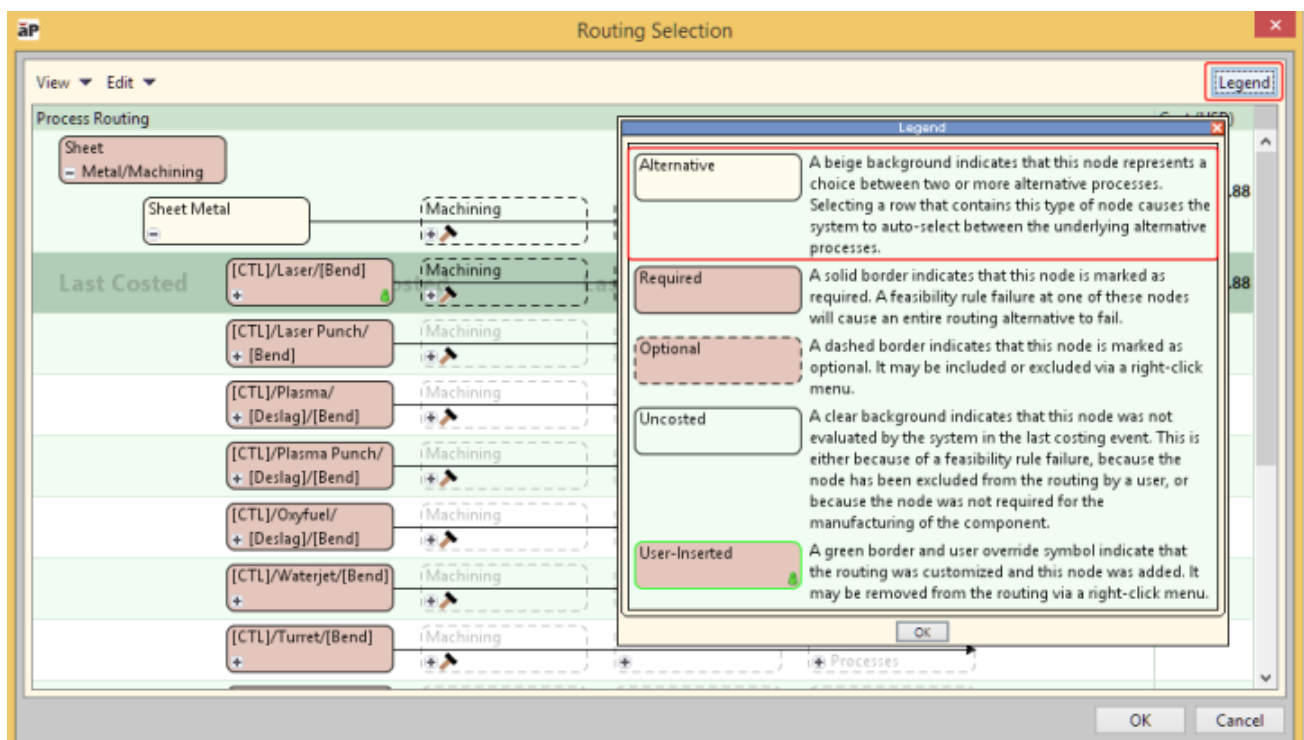
If the components to be costed do not already exist in the database then the Pinned Routing may be left blank and all possible routings will be evaluated.

If you specify an ambiguous routing, aPriori will generate an error message when it attempts to open a Bulk Loader that reads this spreadsheet. (Error messages are displayed as soon as the error is encountered. You may need to iterate through multiple errors and fixes when debugging changes to a User Inputs spreadsheet.)



## Specifying routings with canonical format

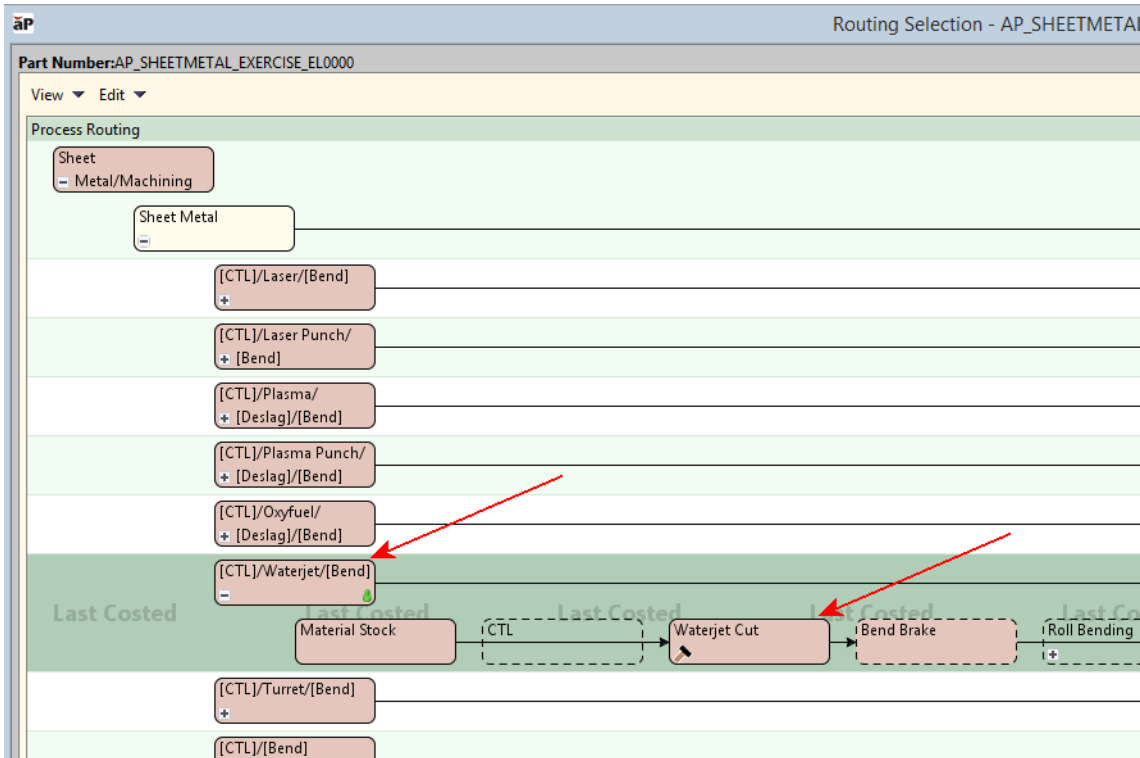
Specifying valid routings requires an understanding of routing formats and how routings are represented in the **Routing Selection** window (see [Selecting a process routing](#) in Chapter 7).



The key to specifying a valid routing is to identify relevant *Alternative* nodes (which are prominently highlighted in beige in the **Routing Selection** window), and then specifying one of the nodes *under* the Alternative node. (If you do not specify a node underneath a particular Alternative node, then all possible sub-routings downstream from that Alternative node are evaluated.)

This is not a *required* approach: aPriori will accept any routing specification that results in a non-ambiguous routing, and it is possible to specify a valid, non-ambiguous routing in multiple ways. However, it is best practice to specify the routing in *canonical* format. This means specifying one of the options underneath every Alternative node (down to the level at which you want aPriori to consider all alternatives), while omitting the names of any other nodes.

Consider the following Waterjet Cut routing in the Sheet Metal process group:



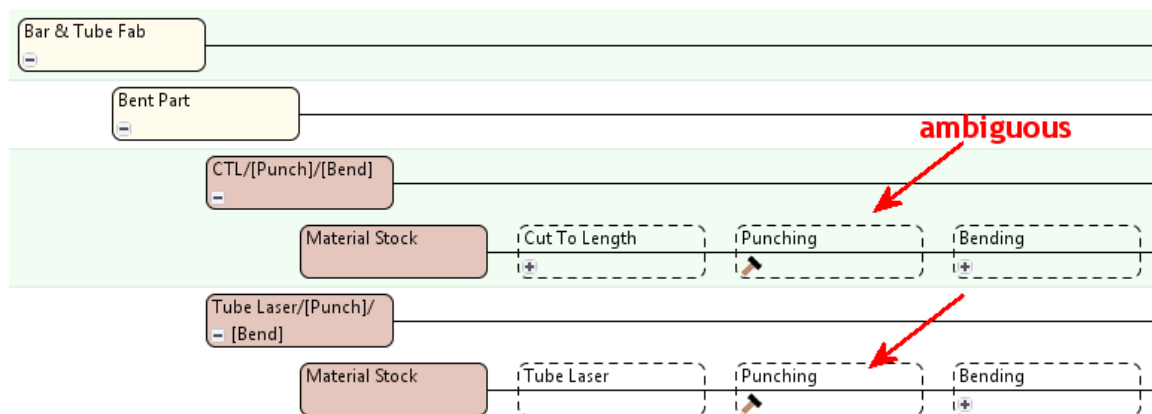
In this particular situation, you could specify the same valid, non-ambiguous routing in at least two ways:

Non-canonical: "Waterjet Cut"

Canonical: "[CTL]/Waterjet/[Bend]"

The non-canonical specification which names a leaf-node ("Waterjet Cut") within the routing works in this case because there is only one "Waterjet Cut" – it happens to specify a non-ambiguous routing, as would canonically specifying the "[CTL]/Waterjet/[Bend]" node underneath the "Sheet Metal" Alternative node.

However, in a similar process in the Bar & Tube process group, specifying the non-canonical "Punching" node would not work because it exists in more than one routing. You need to specify the canonical format "Bent Part, [CTL]/[Punch]/[Bend]" (or at least "[CTL]/[Punch]/[Bend]") to successfully specify a non-ambiguous routing.

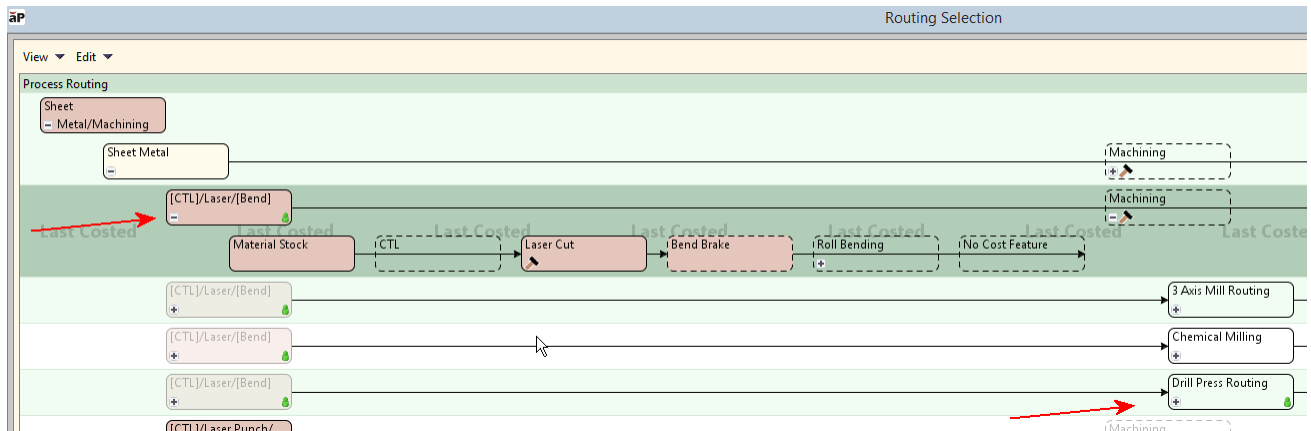


The efficiency of the canonical format becomes more obvious with more complex routings. For example, compare:

Non-canonical: "Sheet Metal/Machining, Sheet Metal, [CTL]/Laser/[Bend], Material Stock, Laser Cut, Bend Brake, Drill Press Routing, Drill Press"

Canonical: "[CTL]/Laser/[Bend], Drill Press Routing"

Both resolve to the same routing when the inputs spreadsheet is imported:



**Note:** When defining comma-separated routings, it can be helpful to collapse/expand nodes using the **Routing Selection** UI to visualize the nodes that you do and do not need to specify. Further note in the example above that Machining (in this case, Drill Press Routing) is a secondary process and it applies to all the routing options under the Primary process. So, no matter what path is chosen from the primary routing, when you exit, you enter the machining routing.

In general, the best way to see the proper syntax for a pinned routing is to pin the routing and then export it from the Bulk Costing UI.

### Routing and feasibility columns

You may notice that the Bulk Costing UI displays two columns next to each other: **Process Routing** and **Pinned Routing**.

Production Info	
Process Routing	Pinned Routing
Vertical Automatic	

When you create a new Bulk Loader, the **Process Routing** column will be populated IF the scenario had a routing pinned in the GUI. If you then create a User Inputs spreadsheet from the Bulk Loader, this value will populate the **pinnedRouting** column in the spreadsheet:

X
<b>pinnedRouting</b>
VerticalAutomatic

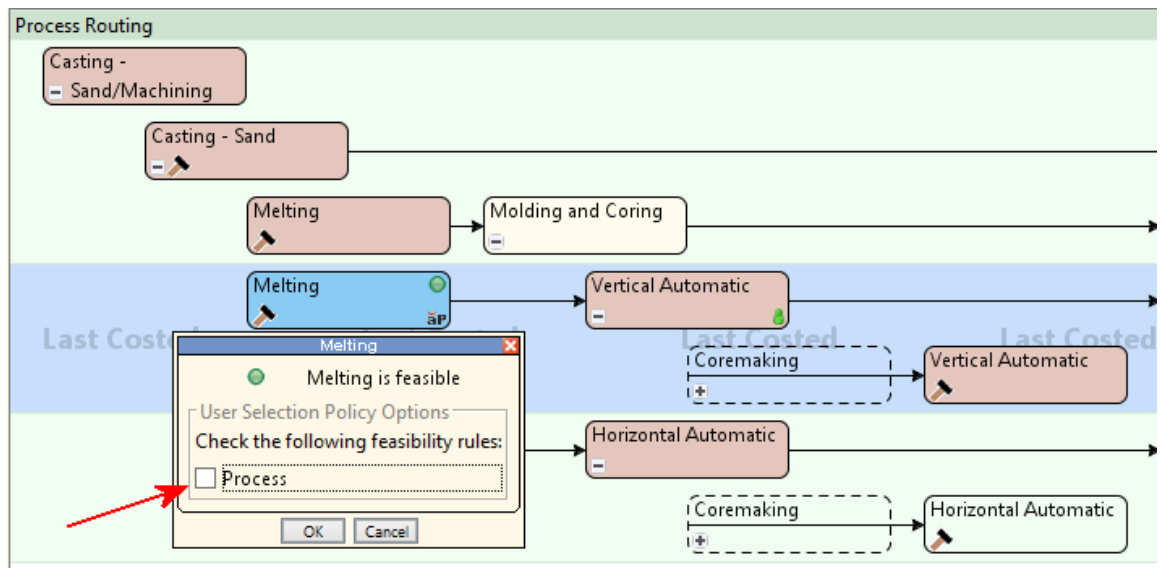
If you change this value (say, to HorizontalAutomatic) and then open the Bulk Loader UI with this User Inputs spreadsheet, both **Process Routing** and **Pinned Routing** columns get updated to the new routing.

Production Info	
Process Routing	Pinned Routing
Horizontal Automatic	HorizontalAutomatic

To implement the “ignore feasibility” feature, append a column to the User Inputs spreadsheet and name it **ignoreAllProcessFeasibility**. Set a value of TRUE for any row for which you wish to turn off process feasibility checks.

AA
<b>ignoreAllProcessFeasibility</b>
TRUE

**Note:** When creating a new User Inputs spreadsheet by using **File > Export User Inputs Spreadsheet**, this column will only appear and be populated if the scenario that created the Bulk Loader had the feasibility rules checkbox unchecked.



## How to specify different datatypes in CSV files

To specify various datatypes in a CSV file, use the following rules:

- 1 If the value is alphabetic or begins with a single quote ('), it is a string and the first apostrophe is stripped. For example, the following are all strings:
  - abc
  - 'abc (becomes abc)
  - '123 (becomes 123)
  - "123 (becomes '123)

- 2 If the input is recognized as numeric, the datatype is a Double. For example, the following are all converted to Doubles

100.00  
1  
-100.00  
-1  
0

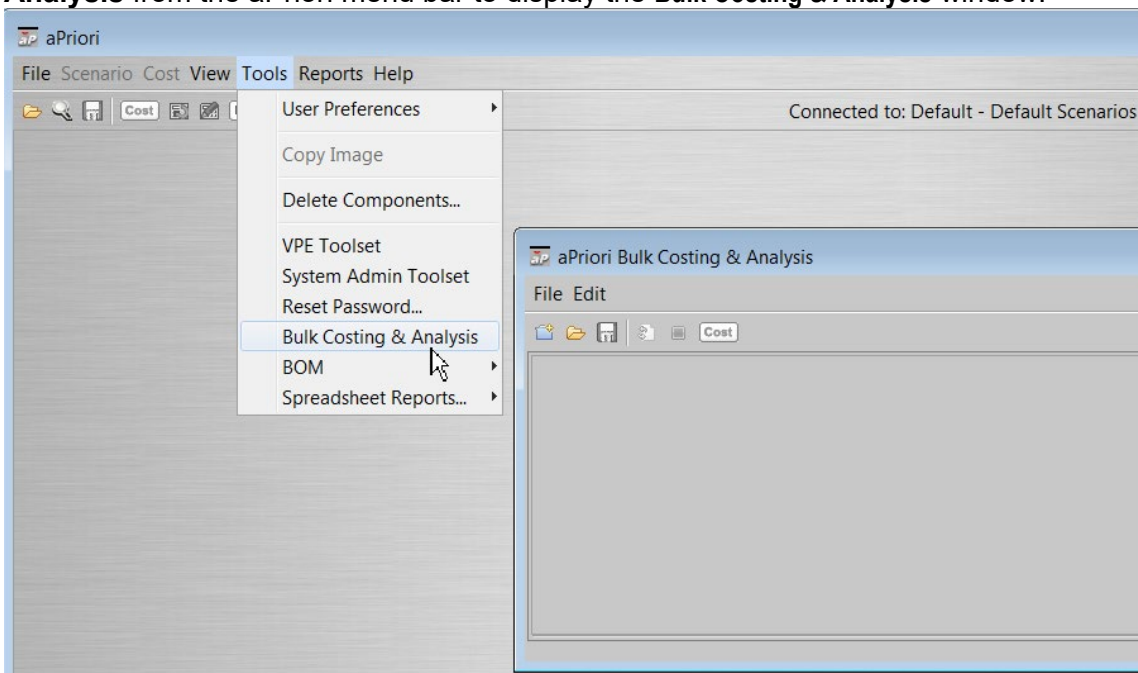
- 3 The following are all recognized as Boolean values:

True  
TRUE  
tRue  
FALSE  
false

- 4 Anything that is not covered above is considered a String.

## Bulk costing groups of parts

To start the licensed version of the Bulk Loader, select **Tools > Bulk Costing & Analysis** from the aPriori menu bar to display the **Bulk Costing & Analysis** window.



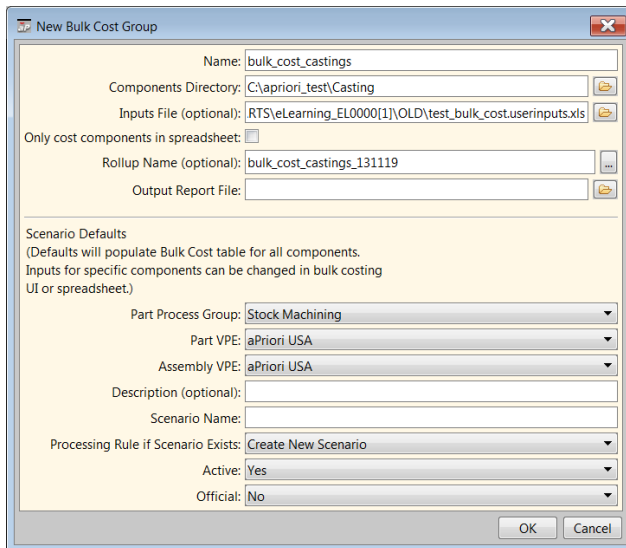
### To create a new bulk cost group

- 1 Determine where (on your computer or network) the parts and assemblies you wish to cost and analyze are located, and how they are organized. The parts that you wish


to analyze together must reside within or underneath the same folder, so you may need to organize the parts and assemblies into either a single folder or a set of sub-folders underneath a single, top-level folder.

**Note:** If the folder contains a part/assembly for a scenario that already exists in the database, aPriori behavior depends on the **processingInputRule** preference setting described at [Scenario support fields](#).


- 2 Select **File > New Bulk Cost Group** from the aPriori **Bulk Costing & Analysis** menu bar to display the **New Bulk Cost Group** window.



- 3 **Name:** Enter a name for the group. If you do not enter this, it will default to the folder name specified in the next step.

- 4 **Components Directory:** Click  next to the field and navigate to and select the folder where the parts and assemblies are located.

aPriori will import all parts and assemblies located in the selected folder and any/all subfolders.

- 5 **Inputs File:** (Optional) Click  next to the field to navigate to and select a user inputs file spreadsheet (in either Excel or CSV format) of cost inputs. For more information, see *Editing bulk costing inputs*.

**Only cost components in spreadsheet:** (Optional) This checkbox appears only when you have specified an inputs file. Leave this box unchecked to cost all of the CAD models in the directory you specify. Check this box to cost only those CAD models specified in the inputs file.

- 6 **Rollup Name:** (Optional) Specify a name for the rollup that will be created from the results of this bulk load. It is good practice to use a descriptive name such as: `bulk_load_test_mm-dd-yyyy`. If you leave this field blank the parts will not be added to a rollup. If you specify a name the dialogue will update and display a new optional field Output Report File.

**Output Report File:** (Optional) This field appears only if you have specified a **Rollup Name** as described above. This field allows you to specify an Excel file that the



Spreadsheet Report will be written to. The name of the file must end in .xls or .xlsx. If you do not specify an output file, no Spreadsheet Report will be created.

- 7 Set values that will serve as scenario defaults for all components. To specify inputs for individual components, go to the **Bulk Costing & Analysis** window, or the **Inputs File** spreadsheet.
  - **Part Process Group** – Select the default process group (Casting, Forging, Sheet Metal, etc.) that will be assigned to parts when not otherwise defined.
  - **Part VPE** – Select the default VPE (Virtual Production Environment, such as “USA”, “China”, “India”, etc.) that will be used to cost non-parent components unless otherwise defined.
  - **Assembly VPE** – Select the default VPE (Virtual Production Environment, such as “USA”, “China”, “India”, etc.) that will be used to cost assemblies unless otherwise defined. This makes it easier to cost products that are assembled in one location using parts produced in other locations.
  - **Description** – (Optional) Enter text that might be helpful to identify or explain the purpose of this Bulk Cost group.
  - **Scenario Name** – See *Scenario support fields on page 298*.

**Processing Rule if Scenario Exists** – See *Scenario support fields on page 298*.

- **Active** – See *Scenario support fields on page 298*.
  - **Official** – See *Scenario support fields on page 298*.
- 8 Click **OK**. The parts and assemblies will be displayed in the aPriori **Bulk Costing & Analysis** window, but not yet costed or analyzed.
  - 9 Click the **Save** button or select **Save** from the **File** menu if you wish to store the bulk cost group at this time.

To enter bulk costing parameters and other information about the components, see *Editing bulk costing inputs on page 300*.

### To open an existing bulk cost group

- 1 Select **File > Open Loader File** from the aPriori **Bulk Costing & Analysis** menu bar to display the **Open Loader File** window.
- 2 Navigate to the desired loader file (loader file filenames end with `.loader.xml`), select it, and click **Open**.
- 3 This displays a pre-populated instance of the **New Bulk Cost Group** window. This gives you the opportunity to adjust the values provided by the loader file. When done, click **OK** to display the **Bulk Costing & Analysis** window with the saved Bulk Cost Group.

### To edit, add, and refresh components from a bulk cost group

- 1 If you specified an **Inputs File** on the **New Bulk Cost Group**, all entries defined in that spreadsheet will by default be read-only in the **Bulk Costing & Analysis** window. To edit an entry, you must first select its checkbox under the **Ignore Excel Inputs** column. (This

column is not displayed if you did not specify an **Inputs File**.

Status	File Name	Scenario	Components Directory	Official	Active	Deep Cost	Processing Input Rule	Ignore	Ignore Excel Inputs	Component Typ
	ap_assem...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PART
	ap_bartub...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	PART
	ap_blow_...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	PART
	ap_bolt_E...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	PART
	ap_forgin...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PART
	ap_injmol...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PART
	ap_machi...	(Official)	Casting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Create New Scenario	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PART

**2** Fields that are editable in the **Bulk Costing & Analysis** window are highlighted; uneditable fields are grayed. You can edit individual entries directly, or you can select multiple entries and change them together using the right-click context menu or the **Edit** menu in the menu bar. (When clicking to select multiple rows, make sure to do so within grayed columns, or you may inadvertently change checkbox settings while selecting.)

**3** To temporarily remove a component from the costing operation, click its **Ignore** checkbox. You can also remove a component permanently if the bulk cost group has been recently created but not yet saved, by deleting its file from the Components Directory and clicking **File > Refresh**.

**Note:** A component will not disappear from the Bulk Costing & Analysis UI even after you remove its CAD file from the Components Directory if:

- It is defined in a user inputs file.
- The bulk cost group was opened from a loader.xml file.

**4** Click the **Save** button or select **Save** from the **File** menu to save your edits.

For more information, see *Bulk costing data fields* on page 297, and *Editing bulk costing inputs* on page 300.

**5** To add new entries for files that have been added to the Components Folder, select **File > Refresh Files**.

### To create a new row from an existing row

You can quickly create a new row in the Bulk Costing & Analysis UI using an existing row as a starting point:

- 1** Select the existing row.
- 2** Click **Create from this row...** from either the **Edit** menu or the right-click context menu.

This menu item is enabled only if:

- One row is selected
- A user inputs file is not provided for this row.

- The component row is CA-connected (“Components Directory” is populated), such that Bulk Costing knows where the CAD file is located.

All inputs of the selected row will be copied to the new row except for the scenario name and the setting of the "official" field.

**Note:** aPriori disables the **Create From This Row** menu item if the CAD file for the selected row is not CAD-connected. The new scenario will fail to cost if there are no GCDs for the new scenario i.e., the Bulk Costing Child process will not copy the scenario).

## Bulk costing part scenarios and assemblies

The Bulk Costing & Analysis utility can simultaneously cost multiple component scenarios, and it can also cost assemblies along with all of their child components (“deep” costing). When you use this facility from the main UI, aPriori pre-populates fields with values from the component(s) you selected.

This means that you can use the Bulk Costing & Analysis tool to generate multiple “what-if” scenarios for a component within a single batch run, making it much easier and faster to compare alternative manufacturing scenarios. For example, you could quickly generate cost estimates for manufacturing a part at two different volume levels, in each of 3 locations by specifying a distinct scenario name to store for each distinct set of Bulk Costing inputs and results.

To use the Bulk Costing & Analysis utility from the main aPriori UI, use the **Cost** menu (see *Using the Cost menu on page 47*).

You can also bulk cost scenarios and assemblies from the separately-licensed Bulk Loader available from the **Tools > Bulk Costing & Analysis** menu option, or from the command line. In these cases, rather than selecting components in the main aPriori UI, you populate the fields directly in the Bulk Costing & Analysis user interface, or through a User Inputs spreadsheet in either Excel or CSV format.

Regardless of how you use access the bulk costing functionality, scenario and assembly support is the same.

For costing different scenarios, see *Scenario support fields on page 298*.

For deep costing assemblies see the next section.

### Deep costing assemblies

“Deep costing” an assembly means costing the assembly and all of its child components. aPriori visits and costs every component of the assembly, including sub-assemblies. The total cost is calculated as the sum of the costs of all sub-components.

**Note:** If you specified an optional **Rollup Name** for output when defining the Bulk Cost Group, the roll-up will NOT include components at the top level if they are sub-components of costed assemblies. They are already included or displayed as children of costed assemblies.

To deep cost an assembly from the main aPriori user interface, open the assembly and select **Cost > Deep Cost Scenario**. This brings up the **Bulk Cost & Analysis** user

interface, pre-populated default values for the assembly. Edit the fields as necessary and click the **Cost** button.

To deep cost an assembly as a Bulk Cost group, select **Tools > Bulk Cost & Analysis** and follow the same general procedures described in *User inputs files* on page 282 for other bulk costing operations. Ensure that the **Deep Cost** checkbox is checked

You must ensure that the Bulk Loader is provided with either or both of the following:

- A directory containing the top-level CAD assembly file to be costed, as well as the CAD files for all of the assembly's sub-components. This is most likely when costing new assemblies that have not been costed before. If a User Inputs file is not provided (see below), default values will be used for costing.
- User Inputs file in either Excel or CSV (comma-separated values) format, containing sub-components with user-defined values rather than default values for costing. This is useful for re-costing assembly scenarios with different user options for comparison analysis. You can create assembly scenarios using the Bulk Loader, but you cannot define the structure of the assembly. You can only specify various user options for the assembly scenario.

### Deep cost behavior

Deep-costing of an assembly tree takes place from the leaves up and occurs in two passes to ensure cost accuracy:

- Pass 1 analyzes the structure of the assembly (that is, it identifies the sub-components).
- Pass 2 costs the assembly after all the sub-components are costed.

If a component scenario belongs to more than one assembly, the component scenario will be costed once.

If a component scenario is set to "**ignore**", the component scenario will not be costed even if it is a sub-component of a deep costing assembly.

For a multi-level assembly, a sub-assembly will be deep-costed automatically if its parent is deep-cost enabled, *even if the sub-assembly is not deep cost enabled*. This allows you to deep-cost an assembly recursively without needing to know the exact structure of the top-level assembly or the deep-cost setting of its sub-assemblies.

### Deep cost status

When deep costing an assembly and all of its children, the Bulk Costing user interface displays the following messages in the Status column. Note that these apply only to assembly deep-costing operations.

- **Processing First Pass...** - The Bulk Loader is analyzing the assembly to determine its structure.
- **First Pass Success** - The Bulk Loader has completed its analysis of the assembly structure.
- **Processing Second Pass...** - The Bulk Loader has costed all sub-components of the assembly and is now completing the assembly costing operation.

## Costing multi-body parts (free bodies)

aPriori can be configured to recognize multi-body CAD files as collections of *free body* parts and cost them as an assembly. This behavior is controlled by various properties. For interactive costing, these properties are set in the `apriori.properties` file, or (as of release 2019 R1) can be set in a **Multi-Body Options** preferences dialog. The `apriori.properties` settings are documented in the “Properties Files” chapter of the aPriori *System Administration Guide*. The **Multi-Body Options** preferences dialog is described at [Multi-Body Options](#).

For Bulk Costing and Analysis, those properties and an additional one are set in `plugin.properties` and prefaced with “`launcher.set`” (for example, `launcher.set.apriori.keep.free.bodies=true`).

This section specifically discusses costing multi-body parts with Bulk Costing and Analysis.

When bulk costing encounters a multi-body, it first creates the structure and then cycles back to pick up the additional bodies.

To enable multi-body bulk costing, set the following properties:

```
In <install>\apriori.properties:
```

```
    apriori.keep.free.bodies=true
```

```
In <install>\ext\analysis-purchasing-module\plugin.properties:
```

```
    launcher.set.apriori.keep.free.bodies=true
```

```
    launcher.set.apriori.cost.free.bodies.as.assembly=true
```

**Note:** Ensure that there is no trailing space after “true”.

**launcher.set.apriori.cost.free.bodies.as.assembly** is a setting that is recognized only in Bulk Costing. When set to true, aPriori will cost each body as a part with the same costing inputs and then aggregate the costs at the assembly level. When free body parts get added to the Bulk Loader automatically (that is, if you load a multi-body CAD file containing free body parts), the free body parts appear in their own rows in the Bulk Costing & Analysis UI for the purposes of showing costing status. However, they are not editable, and they will not be saved in the Bulk Loader files (\*.loader.xml), or to any exported CSV or Excel spreadsheet file. They inherit all their inputs from the parent assembly/multi-body part.

**Note:** If `launcher.set.apriori.keep.free.bodies=true` and `launcher.set.apriori.cost.free.bodies.as.assembly=false`, then only the top-level assembly will be costed and rows for assembly sub-components will not be added to the bulk cost group.

**IMPORTANT:** It is critical that you keep the common settings (i.e., all free body properties OTHER than `apriori.cost.free.bodies.as.assembly`) in `apriori.properties` and `plugin.properties` consistent. If you change the `free.bodies` setting in one, you must change it the same way in the other. Failure to do so can result in unexpected behavior such as assemblies being created with no subcomponents.

It should also be noted that bulk costing does not notify you if multi-body component scenarios are open in the UI when you initiate a bulk costing operation. However, when the bulk costing is finished, aPriori does display a list of components (including multi-body components) that are opened in the UI and which should be refreshed.

### Limitations with multi-body STEP assemblies

Bulk costing STEP assemblies with multi-bodies present some special challenges and require some workaround procedures. You cannot directly Deep Cost and save multi-body STEP assemblies, but you can Deep Cost the resulting Rollup. The limitation with this workaround is that you cannot save and later re-open the Bulk Cost file: you must Deep Cost the Rollup scenario again.

### To bulk cost a multi-body STEP assembly

- 5 Make sure that the free body properties are set as described in the previous section.
- 6 Create a new bulk cost group for the multi-body STEP assembly as described in [. To create a new bulk cost group](#)  
 Make sure to specify a **Rollup Name**. Click **Ok** in the New Bulk Cost Group dialog box when done.
- 3 Click the **Cost** button in the **aPriori Bulk Costing & Analysis** window, then click **OK** when the **Bulk Costing Complete** window appears.
- 4 When the main aPriori window comes up showing the rollup you specified in Step 2, click **Cost > Deep Cost Scenario**. This displays the aPriori Bulk Costing & Analysis window again, this time showing the rollup, with all the subcomponents accessible and visible in the table. However, note that the Bulk Cost file cannot be saved to re-open later, and that you will need to Deep Cost the Rollup scenario again to get back to the table.

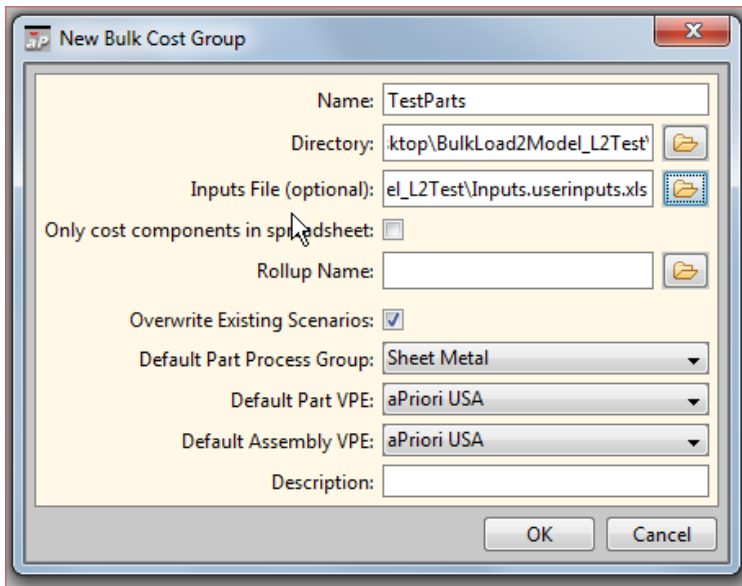
### Bulk Costing 2-Model Machining Parts

To bulk cost 2-Model Machining components, you must specify the source component though the user inputs file. (For general information about 2-Model Machining, see the chapter "2-Model Machining Process Group" in the aPriori *Cost Model Guide*.)

- 1 Create a user inputs Excel file that contains columns **sourceModel** and **sourceModelScenario**. If **sourceModelScenario** is blank, the effective scenario is the Official scenario. Also note that the **processGroup** of the finished model should be "2-Model Machining".

<u>cadFileName</u>	<u>processGroup</u>	<u>sourceModel</u>	<u>sourceModelScenario</u>	<u>targetCost</u>	<u>targetFile</u>
ap_casting_BEFORE_machining_872506.STP	Casting				
ap_casting_AFTER_machining_872506.STP	2-Model Machining	ap_casting_BEFORE_machining_872506			

- 2 Create a Bulk Cost Group in the Bulk Loader UI using your spread sheet and source/finished model CAD files.



- 3 Click the **Cost** button. The **Status** of the finished model is "Processing Deferred" until the source model is costed.

TestParts (2 components)							
File							
File Name	Directory	Status	Scenario Name	Make Official	Active	Deep Cost	Overri
finalShape.SLDPRT		Processing Deferred		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
initialShape.SLDPRT		Processing...		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Note:** The Bulk Loader first scans the inputs file for any 2-model components. If it finds any, it first costs the non-2-model components, and then afterwards cycles back and costs the 2-model components.

## Bulk costing data fields

There are four groups of input data fields associated with the components in a bulk cost group: Production Info, Quoted Cost Info, Administrative Info and Process Routing.

Production Info fields are required to initially cost the part or assembly and include:

- **Process Group**
- **Annual Volume**
- **Production Life**
- **Plant Name (VPE)**
- **Material Composition**

If the values for these fields are not specified in the Bulk Cost Group, aPriori will use the VPE default values.

Quoted Cost Info fields allows a user to enter a current cost or quote information, which is used subsequently in cost per mass analyses and for comparison to the aPriori cost estimate. These are optional fields and include the following:

- **Quote Total part Cost**
- **Quote Tooling Cost**
- **Quote Material Composition**
- **Quote Process Group**
- **Quote Annual volume**
- **Quote Routing**
- **Quote Date**
- **Quote Factory**

Administrative Info groups optional fields containing descriptive information about the parts, which may be useful for subsequent searching and analysis. These fields include:

- **Part Description**
- **Product Line**
- **Model Number**
- **Project**

Process Routing fields display the routing specified and/or chosen by aPriori for the component.

By default, the Process Routing field is blank initially, and aPriori will automatically determine the routing and machine which will result in the lowest cost.

You also can specify the routing and machine to be used when bulk costing components. To do this, select one or more parts in the table and select **Edit > Edit Process Routing**. (Edit Process Routing also is available from the right mouse button popup menu). See *Selecting a process routing on page 182* for detailed instructions.

**Note:** If a bulk costing part includes required UDAs (User Defined Attributes), verification that the required UDA(s) exist is done during initialization of components. This means that if a required UDA is not specified, you get an error message only once all components in the bulk cost group are initialized/costed.

## Scenario support fields

aPriori provides several fields to support multiple scenarios:

- **scenario** – You can specify that multiple scenarios for a single part or assembly should be costed during the Bulk Cost operation. Each scenario requires a different row in the Bulk Costing & Analysis UI and in the User Inputs spreadsheet. The Scenario field in the Bulk Costing & Analysis UI provides a pull-down menu showing the scenarios that are legal to change to. You cannot, for example, have two instances of the same scenario for the same part. You also cannot edit the scenario if the row is not defined in a User Inputs file.



- **official** – When set to TRUE in the User Inputs spreadsheet, or “checked” in the Bulk Costing & Analysis table, the scenario specified in the row is made the official scenario. (Default = FALSE.) Note that if a component has not been initialized, the first scenario created by the Bulk Loader is made official even if this field is False. If the Bulk Loader processes a subsequent scenario that is marked “Official” for the component, it will supersede the official status of the first scenario. However, note that you cannot assume in what order the Bulk Loader will process rows: variables such as sorting by column in the UI, or setting `bulkload.concurrent.loader.count` to a value greater than “1” in `plugin.properties`, can result in rows being processed in a different order than you might expect.
- **active** – When set to TRUE in the User Inputs spreadsheet, or checked in the Bulk Costing & Analysis table, CAD-connected components will be updated whenever the CAD part changes. Setting a part to Inactive means that GCDs remain static even if the CAD part is updated and must be updated manually before changes to the CAD files will be reflected in the Bulk Cost operation. This field is optional; if not explicitly set, the default is TRUE.
- **deep cost** – (Default = FALSE) When set to TRUE in the User Inputs spreadsheet, or checked in the Bulk Costing & Analysis table, the children of assemblies or roll-ups will also be costed. This field is disabled in the UI for non-parent components.
- **processingInputRule** – What to do if the scenario already exists:
  - **Update** – (Default) Add new inputs to the existing scenario and retain any existing inputs that are not changed through the Bulk Cost update. This merges new inputs into the existing scenario, overriding the specified input selections.
  - **Skip** – Do not process; skip component scenario.
  - **Create New Scenario** – Create a new scenario by copying from the existing scenario and then applying the inputs provided through Bulk Costing. If the scenario name already exists, increment it. For example: **Final(2)**
  - **Clear Existing Data & Reload** -- Clear all inputs and outputs for the scenario and recost using the inputs defined in the Bulk Cost run.

## Bulk costing required User Defined Attributes

If you provide a scenario name that exists in the database when you initialize bulk costing, aPriori populates the inputs with everything that currently exists for that scenario. Therefore, if you have User Defined Attribute values for “Part1-scenario1”, and you start a bulk costing that includes “Part1” and “scenario1” in the New Bulk Cost Group dialog box, then the existing UDA values will be used. Since they exist, they will be used no matter what Processing Input Rule you have selected.

If you change the scenario name in the bulk costing UI, then aPriori does not load that data from the database, and whatever values you provide in the bulk costing UI is used (again, regardless of what Processing Input Rule you have selected). So if you create a new bulk cost group with scenario name “scenario0” and then in the bulk cost UI you

change the scenario name to “scenario1”, it doesn’t matter that Part1 already has UDA values in aPriori -- the bulk costing UI is not filled out with UDA values.

In summary, you can enter values for UDAs when bulk costing, and must provide values for required attributes. If you are bulk cost existing components and want to use existing required attribute values, you must do one of the following:

- Collect all scenarios into a container (assembly, roll-up, or dynamic roll-up) and use Deep Costing. The existing UDA values will be pulled in for all scenarios.
- If all scenarios have the same scenario name, ensure that that scenario is used when creating the new bulk cost group. All existing UDA values will be pulled into the bulk costing UI.

## Creating scenarios through Bulk Costing

This section describes some things to consider when you are creating or running a Bulk Costing Group without any scenarios already in the database.

Suppose the parts you are bulk costing have not been previously costed and therefore do not yet exist in the database. If you run bulk costing with an Excel User Inputs spreadsheet that specifies two scenarios, you should specify one (and only one) of the two scenarios to be official. If you specify more than one scenario for the same part to be official, aPriori displays an error message when you try to run the Bulk Loader.

If neither scenario is specified to be official, the Bulk Loader makes the first scenario it processes the official one.

If parts are already stored in the database and an official scenario already exists, you can set "official" to put any scenario in official status. If "official" is left blank or set to FALSE, the Bulk Loader will not alter official status.

## Editing bulk costing inputs

There are four ways to enter information about the components in a bulk cost group:

- 1 Enter information one part at a time in the aPriori Bulk Costing & Analysis table.  
For each field you wish to edit, select the field and enter the desired value. Many fields can be typed in by simply double-clicking on the field. You can also select an option from the right-mouse popup menu.
- 2 Enter identical information for multiple parts at a time  
Select multiple parts, holding the control key and clicking the left mouse button to select the fields you want to edit. Then click the right-mouse button and select the appropriate menu option corresponding to the group of data that you want to edit (Production Info, Administrative Info, Quoted Cost, or Process Routing). A pop-up window will appear where you can set the inputs. Enter the desired data and click OK.
- 3 Use Microsoft Excel to facilitate mass-entering of bulk cost data fields
  - Copy the data in the aPriori Bulk Costing & Analysis table to Microsoft Excel by selecting **Copy Entire Table** from the **Edit** menu.

- Paste the information into Microsoft Excel.
- Enter the desired values into the Microsoft Excel worksheet
- Select the data in Microsoft Excel and paste back into aPriori (select Paste from the **Edit** menu in the aPriori Bulk Costing & Analysis window). If pasting the entire table, move the cursor to the first row of the table in aPriori, click, and Paste from the **Edit** menu.

Parts must be in the same order in the Bulking Costing Tool and Excel when copying data from Excel into aPriori.

All fields except for Process Routing can be specified in Excel. If you would like to set a specific routing for a part or group of parts, it must be set in aPriori.

**Note:** You cannot enter TRUE/FALSE data in Excel cells that are of type = 2. You must change the cells to be type = 4 for them to work properly.

If setting the material composition field in Excel, you must use the exact same material composition name that is used in the selected VPE's material table.

- 4 Specify an external spreadsheet (Inputs File) to provide inputs to Bulk Costing and Analysis. If an Inputs File is specified, data from the file takes precedence over information entered directly into the Bulk Costing & Analysis table.
- 5 After you have completed entering/editing information about the components in a bulk cost group, Save the bulk cost group and proceed to costing.

**Note:** Production input values provided in this file take precedence over values from other sources. See [Precedence of production input overrides](#) for more information.

## Bulk Costing Menu Reference

The **Bulk Costing & Analysis** window provides the following commands and features on both the right-click context menu and the **Edit** menu. (Some of these features are also available as fields in Bulk Costing tabular user interface ):


Menu Command	Description
<b>Copy Entire Table</b> <b>Copy</b> <b>Paste</b>	( <b>Edit</b> menu only) <b>Copy</b> applies to the currently selected row(s). <b>Copy Entire Table</b> is useful for capturing all contents of the window for pasting into a spreadsheet or other document. <b>Paste</b> copies clipboard data into the table. See <i>Editing bulk costing inputs</i> above for details.
<b>Create From This Row</b>	Create a new row in the Bulk Costing & Analysis UI using an existing row as a starting point. See <i>To edit, add, and refresh components from a bulk cost group</i> above for details.
<b>Edit Production Info</b> <b>Edit Administrative Info</b> <b>Edit Quoted Cost</b>	For Production Info, Administrative Info, and Quoted Cost, see the description at <i>Using the Cost Object Info window</i> .

Menu Command	Description
<b>Edit Process Routing</b> <b>Edit Cost Overrides</b> <b>Summary</b> <b>Edit Process Setup</b> <b>Options</b>	For Process Routing, see <i>Selecting a process routing</i> .  For Cost Overrides, see <i>Working with the Overrides Summary dialog</i> .  For Process Setup Options, see <i>Editing process setup options</i> .
<b>Make Official</b> <b>Undo Make Official</b>	Specify whether or not the selected scenario is to be made the scenario that by default gets rolled into its parent assembly or roll-up. See the description for the Scenario menu in the main UI at <i>Working with scenarios</i> .
<b>Make Active (Scenario)</b> <b>Make Inactive (Scenario)</b>	Specify whether or not the selected scenario is automatically updated with CAD changes. See the description for the Scenario menu in the main UI at <i>Working with scenarios</i> .
<b>Extract GCDs</b> <b>Do Not Extract GCDs</b>	Controls whether or not aPriori should re-extract the latest geometry of the CAD model. If you are sure that the geometry of a component's CAD file has not changed since the last time the part was costed and saved in the aPriori database, then you can choose to not extract GCDs. aPriori will simply use the previously-saved set of GCDs without re-analyzing the CAD model, reducing the total amount of time required for aPriori to cost the component.
<b>Deep Cost</b> <b>Undo Deep Cost</b>	Set whether or not deep costing is enabled. See <i>Scenario support fields</i> for more details.
<b>Edit Processing Input</b> <b>Rule...</b>	Specify how aPriori should handle existing scenarios. See the description at <i>Scenario support fields</i> for more details.
<b>Ignore</b> <b>Undo Ignore</b>	If a component scenario is set to "ignore", the component scenario will not be costed even if it is a sub-component of a deep costing assembly. See the section "A note about Ignore, Hide, and their effect on costing" in the aPriori <i>Cost Model Guide</i> for more details.
<b>Ignore Excel Inputs</b> <b>Undo Ignore Excel Inputs</b>	Control whether fields in the Bulk Costing & Analysis UI are updated from the Excel input file or can be edited locally. See <i>To edit, add, and refresh components from a bulk cost group</i> for more details.
<b>Select Image File</b>	(Context menu only) Specify the full path of a 2D image file to associate with a CAD-less (virtual) part or assembly. See <i>Associating an image without a CAD file</i> for more details.

# Costing a bulk cost group

Once you have set the bulk cost input fields as desired, you are ready to cost the bulk cost group. The time required to cost the group is dependent on the number and complexity of the components in the group.

## To cost a bulk cost group

- 1 Select the  button to cost the group of parts.
- 2 If any of the components in the bulk cost group have previously been costed, the Begin Bulk Costing window will appear with a message that identifies these components and asks if you want to continue.
  - If you select Yes, the official scenarios of the previously costed parts will be overwritten.
  - If you do not want to overwrite the previous official scenarios, you can remove the component(s) from the bulk cost group. Alternatively, before bulk costing, you could first go to the main aPriori application and create a new scenario for a part that is a copy of the official scenario. This new scenario will then retain the previously-costed value.
- 3 Specify how to group cost results once the bulk costing has completed on the **Add to Rollup** window. You can:
  - Add to existing rollup
  - Include in new rollup
  - Do not include in a rollup

By default, all the components in the bulk costing group are included in a new roll-up.

If you are costing a large group of unrelated parts that you ultimately want to analyze in smaller cohesive groups, select “Do not include in a rollup.” When the parts have completed costing, then you can create rollups based on relevant groupings (i.e., all plastic parts in a specific project, sheet metal parts costed on a specific date etc.)

For more information on using Rollups, see [Using roll-ups on page 95](#).

Select an option and click **OK**.

- 4 aPriori will begin costing each component in turn in the main aPriori window. When aPriori has completed costing the bulk cost group, the Bulk Costing Complete window will appear.

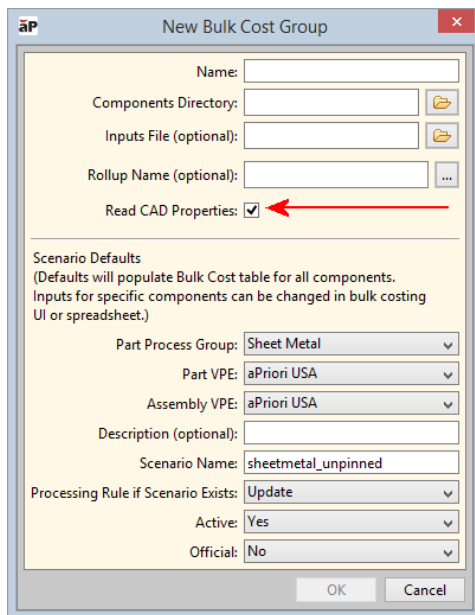
The window will note the total number of components processed and the number that costed successfully. If any components failed to cost or only partially costed, the system will identify those components and provide details of the costing issues for each component. For more information on understanding costing failures during Bulk Costing, see [Understanding cost failures during bulk costing on page 314](#).

Click **OK** to dismiss the window. The Bulk Cost and Analysis results will be displayed in a rollup in the main aPriori window.

## Costing with CAD properties

Your aPriori System Administrator may have configured your deployment to automatically extract properties or parameters from the CAD file and map those values to aPriori production inputs or User Defined Attributes (UDAs). (See [Costing with CAD Properties](#) in this document, and the chapter “Using CAD Properties” in the aPriori Professional *System Administration Guide*.)

If so, you can specify that bulk costing extract these properties directly from the CAD file as soon as you load the bulk costing screen. There is a property that enables this behavior in `<aPriori_install>\ext\analysis-purchasing-module\lugin.properties: bulkload.readCadProperties=true`. There is also a **Read CAD Properties** checkbox which reflects this setting, which appears in the **New Bulk Costing Group** dialog:



**Note:** If your administrator has a CAD properties mapping file in place and your CAD file(s) contain those properties, loading the bulk costing UI will incur a performance cost due to the property extraction process. You can choose whether to take that performance hit up front (by checking the **Read CAD Properties** checkbox, or later during costing (by leaving the box unchecked). If you check the box, the extraction process will be cached for two days. If you leave the box unchecked, you will encounter the performance hit whenever you cost your bulk costing group. aPriori recommends that you leave the box checked.

## Costing without a CAD file

The aPriori Bulk Loader provides the ability to cost or re-cost a part without having a CAD file present. This capability is available in two situations:

- After costing a part once with the CAD file present, you can re-cost that same part without the CAD file. This is useful, for example, if a non-designer like a cost

analyst wants to try recosting a part with different inputs, but who may not have access to the engineering CAD files. Ensure that:

The **Process Group** specified in the `userinputs.xls` file is the same as the one used when the scenario was costed with the CAD file present. The CAD-less process group must be the same as when the component was originally costed.

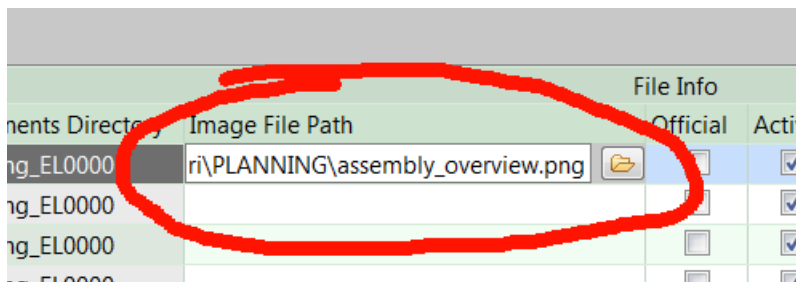
In the **Bulk Cost Group** dialog, the **Only cost components in spreadsheet** checkbox is enabled.

In the **Bulk Cost Group** dialog, the **Processing Rule if Scenario Exists** is set to **Update**.

- You can also define a non-CAD part in a User Inputs file, specifying basic component geometry fields such as volume, surface area, length, height, width, and cost it with the Bulk Loader without having any CAD file at all. The component **MUST** be cost with the User Guided process group.

## Associating an image without a CAD file

As of aPriori Release 2014 R1 SP1, you can associate an image file with a CAD-less (virtual) part or assembly. This image will appear where a CAD-related component typically displays a representation of the CAD model, such as the **Component Viewer** or **Search** dialog in the main aPriori GUI. To associate an image with a virtual component part in the Bulk Loader, use the folder icon to specify the full path to the image file under the **Image File Path** column in the **File Info** section of the Bulk Costing and Analysis UI:



For information about using images in the aPriori UI, see *Specifying 2D Images for virtual components*. Note that in the Bulk Costing & Analysis UI you can right-click and select **Image File** to specify the full path to the 2D image file. You can also specify this path in a Bulk Costing Excel user inputs file or BOM input file using the `imageFilePath` property.

## Cost Overrides

You can override certain computed values in bulk costing the same way you can in the main aPriori client. However, bulk costing does not provide any validation or error checking of overrides, so you must be careful when implementing these overrides, please refer to the override information in the main UI documentation when determining which values you can override. Start with *Overriding computed values* on page 112. You can also find override details in the *Cost Model Guide*.

# Reviewing bulk costing and analysis results

After batch costing groups of parts, aPriori automatically executes two analyses:

- **Cost per Mass Analysis.** aPriori determines the average cost per mass, shows you which parts' cost per mass are above the average, and computes the potential cost reduction opportunity by annualizing the per component savings based on production volume.
- **Cost Comparison.** aPriori calculates the variance between an existing part cost (from a current cost or quote) and an aPriori cost estimate. You can sort to find the parts with the greatest variance. These parts are the most likely candidates for cost reduction.

The Bulk Costing and Analysis module uses Rollups to display cost analysis results.

The Bulk Costing & Analysis Output includes all fields that are typically available in a Rollup plus some additional categories of data elements: Quote Info, Quoted Cost Per Mass Analysis, Cost Comparison (compares aPriori Cost to Quoted Cost), aPriori Cost per Mass, Stock Dimensions and GCD Summary. The full set of fields contained in these categories is listed later in this section.

To identify outliers, navigate to the Headings "Quoted Cost Per Mass" and "Cost Comparison." By looking at the cost per mass based on the price you're currently paying and a comparison of the current cost to the aPriori cost, you can quickly ID outliers and rank those with the greatest potential cost savings. Identify the outliers with largest cost-down potential by sorting on "Est. Annual Savings Based on Avg. Quote Cost Per Mass" and "Est. Annual Savings Based on Var. Between aPriori & Quoted Cost."

Notes about Quoted Cost Per Mass:

- $\text{Quote Cost Per Finish Mass} = \text{Finish Mass} / \text{Quoted Total Cost}$
- $\% \text{ Var. from Avg. Quote Cost Per Mass} = \text{percent difference between the part's cost per mass and the average quoted cost per mass of the group. The average cost per mass is automatically calculated for any rollup that you create.}$
- **Tip:** Analyzing the % Variance for the Avg. Cost per Mass is meaningful only if you have related parts in the rollup. aPriori recommends that you, at a minimum, group parts by process family. Additionally, you may want to segregate parts even further considering variables such as product line, supplier, part type etc.
- **Est. Component Savings Based on Avg. Quote Cost Per Mass** shows how much a part would cost if it had the average cost per mass.
- **Est. Annual Savings Based on Avg. Quote Cost Per Mass** equals **Estimated Component Savings \* annual volume.**

The Bulk Costing Analysis fields are displayed in groups in the rollup and are listed below:

- **Quote Info:**  
Quoted Total Cost  
Quoted Total  
Capital Investment  
Quoted Material Composition



Quoted Process Group  
Quoted Annual Volume  
Quoted Routing  
Quoted Date  
Quoted Factory (Source)

- Quote Cost Per Mass

Quote Cost Per Finish Mass  
% Var. from Avg. Quote Cost Per Mass  
Est. Component Savings Based On Avg. Quote Cost Per Mass  
Est. Annual Savings Based On Avg. Quote Cost Per Mass

- aPriori Cost Per Mass

aPriori Cost Per Finish Mass  
% Var. From Avg. aPriori Cost Per Mass  
Est. Component Savings Based On Avg. aPriori Cost Per Mass  
Est. Annual Savings Based On Avg. aPriori Cost Per Mass

- Cost Comparison

aPriori vs. Quoted Cost (Diff)  
aPriori vs. Quoted Cost (% Diff)  
Est. Annual Savings Based on Var. Between aPriori & Quoted Cost

- Stock Dimensions

For components costed in process groups utilizing material stock, the following stock fields are populated:

Stock Form  
Stock Width  
Stock Height  
Stock Length  
Stock Thickness  
Stock Wall Thickness  
Stock Inside Diameter  
Stock Outside Diameter

- GCD Summary

The number of GCDs of each type below are displayed for each component in the rollup:

Assembly Component GCD  
Blank  
Bulk Removal  
Closed Bend  
Combo Void  
Complex Hole  
Corner Pick  
Cross Section  
Curved Bend  
Curved Surface  
Curved Wall  
Edge  
End  
Form  
Heli Groove

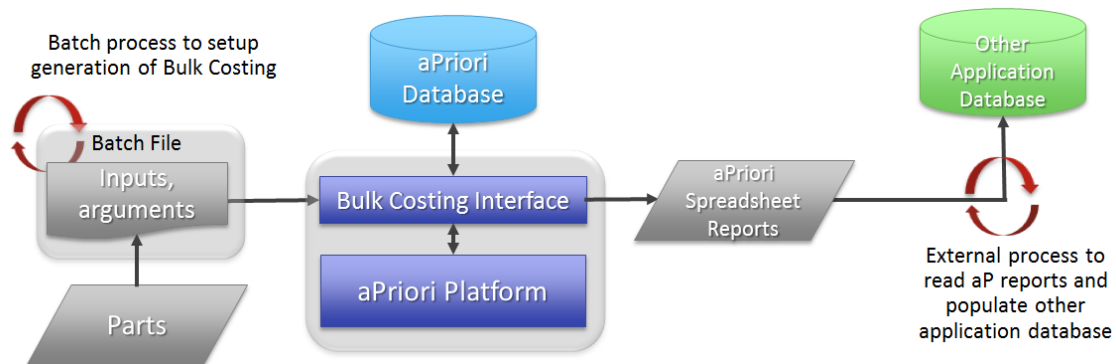
Keyway  
 Lance  
 Main Surface  
 Multi Step Hole  
 Not Supported  
 Parting Line  
 Planar Face  
 Pocket Ring  
 Setup Axis  
 Sharp Edge  
 Simple Hole  
 Stock Trim  
 Straight Bend  
 Turning Axis  
 Void  
 Weld

## Running from the Command Line

The Bulk Costing and Analysis module can run from the command line in "batch" mode, without starting the aPriori user interface.

This provides the benefits of:

- allowing batch cost analysis of many parts at a single time in an automated and scheduled fashion
- using bulk costing for activities like Spend Analytics
- running bulk costing as an offline process



Costing inputs can be specified through spreadsheets, and cost estimates and related data of interest can be output to spreadsheets. This enables you to interface aPriori with other product lifecycle management systems to support fully-automated batch costing. For example, an upstream system may prepare a set of CAD files and a corresponding set of cost inputs to pass to aPriori and initiate a Bulk Costing session; the outputs of the session can then be passed to another downstream system.

**Note:** If you set `bulkLoader.watchpointXlsFile` in the properties file, you must also set `bulkLoader.rollupName` or no report will be generated.

# bulkLoad.cmd

To run Bulk Costing from the command line, use the `bulkLoad.cmd` command, which is found in

```
apriori_install\version\install\bin
```

This command takes three arguments which must be specified in the exact order shown below.

**Note:** Do not map a network drive to the aPriori installation folder and then use that mapped drive when running the `bulkLoad` command. Doing so will cause the `bulkLoad` command to fail with a log entry similar to "RuntimeException executing:Cannot build ClassLoader from dependencies.txt Msg:Cannot find dependencies file:Z:\install-support\antscripts\lib\classpath-win64.txt"

## Syntax

```
bulkLoad.cmd props_file [username password]
```

## Arguments

`props_file` -- The path to the properties file, which contains the same inputs that are provided via the user interface when running interactively. See *bulkLoad.properties file* below for more information.

`username` -- The aPriori log-in account name to use for this session.

`password` -- The associated aPriori password.

Note that if `username` and `password` are not specified as arguments on the command line, the Bulk Loader looks for them in the properties file. If not found there, and if your aPriori administrator has implemented Single Sign On (SSO), the Bulk Loader attempts to use the currently logged-in user's Windows credentials.

## Example

Create a batch file named `bulk.bat` with the following contents that makes a call to the `bulkLoad.cmd` command. (`username` and `password` are shown as part of the batch file, but you should consider providing these at run time,

```
call BulkLoad.cmd C:\Files\bulkLoad.properties myUserName myPassword
```

## Important Note About Forward and Back Slashes

When using the command line, paths should be specified with Windows backslashes, as you would expect. However, paths specified within properties files must be specified with UNIX-style forward slashes. The example in the previous section correctly shows the command line using Windows-style backslashes to specify the `bulkLoad.properties` file. However, any paths WITHIN the `bulkLoad.properties` file must use forward slashes, such as: `bulkLoader.partsDir=C:/BulkLoad_Test/CAD_files`

## bulkLoad.properties file

The bulkLoad.properties file specifies the predefined bulk costing inputs required by the bulkLoad.cmd command.

aPriori provides a sample file named `bulkLoadTemplate.properties` at `install\ext\analysis-purchasing-module\command-line\`

Note that paths specified within this file must use UNIX-style forward slashes. In addition, you can add entries from the `apriori.properties` and the `bulk loader plugin.properties` (see below) which will override the values set in those files. Note that paths specified within these files must use UNIX-style forward slashes.

Properties file entries	Description
<code>bulkLoader.name=</code>	Corresponds to the Name field in the user interface.
<code>bulkLoader.partsDir=&lt;directory of parts&gt;</code>	Corresponds to the Directory field in the user interface. Note that this property and any other path properties in this file must be specified with UNIX-style forward slashes, such as <code>C:/BulkLoad Test/CAD files</code>
<code>bulkLoader.inputsFile=&lt;input excel file&gt;</code>	Optional - Corresponds to the Inputs File field in the user interface.
<code>bulkLoader.rollupName=&lt;name of Rollup&gt;</code>	Optional - Corresponds to the Rollup Name field in the user interface. Note: Must be specified when <code>bulkLoader.watchpointXlsFile</code> is set, or no report will be generated.
<code>bulkLoader.processingInputRule = &lt;update skip create_new_scenario clear_existing&gt;</code>	Optional – Corresponds to the “Processing rule if scenario exists” drop-down box.
<code>bulkLoader.active=&lt;true false&gt;</code>	Optional – Corresponds to the Active field in the user interface, which takes yes no rather than true false values.
<code>bulkLoader.official=&lt;true false&gt;</code>	Optional – Corresponds to the Official field in the User Interfac, which takes yes no rather than true false values e.
<code>bulkLoader.onlyCostSpreadsheetComponents=&lt;true/false&gt;</code>	Corresponds to the “Only cost components in spreadsheet” field in the user interface.
<code>bulkLoader.defaultProcessGroup=&lt;default process group name&gt;</code>	Corresponds to the Default Part Process Group field in the user interface.
<code>bulkLoader.defaultPartVpe=&lt;default part vpe&gt;</code>	Corresponds to the Default Part VPE field in the user interface.
<code>bulkLoader.defaultAssemblyVpe=&lt;default assembly vpe&gt;</code>	Corresponds to the Default Assembly VPE field in the user interface.
<code>bulkLoader.description=&lt;text&gt;</code>	Optional - Corresponds to the Description field in the user interface.
<code>bulkLoader.username=&lt;username&gt;</code>	Required if not entered on the command line, and if your site has not implemented Single Sign On to automatically use your logged-in Windows credentials. Otherwise specify your aPriori username.

bulkLoader.password=<password>	This is the aPriori password used to log in to the application. Not required if it has been entered on the command line, or if your company has implemented Single Sign On (SSO) to automatically use your logged-in Windows credentials. In summary, for SSO-enabled installations, leave username and password blank to have the Bulk Loader job run under the Windows username and password.
bulkLoader.deployment=<deployment>	Required. This must specify the name of the deployment you wish to connect to.
bulkLoader.schemaname=<schemaname>	Required. Set this to point to the component schema associated with the deployment you specified above. The schema must be configured in the aPriori database.
bulkLoader.xmlFile= <previously exported bulk loader XML file>	Optional - Set this to use an existing bulk loader file. This is the same as Open Loader File functionality in the user interface.
bulkLoader.watchpointXmlFile= <watchpoint input file>	Optional - This is the name and path of the watchpoint input file.
bulkLoader.watchpointXlsFile= <watchpoint output spreadsheet>	Optional - This is the name and path of the watchpoint output report file. Note: If you set this property, you must also set bulkLoader.rollupName or no report will be generated.

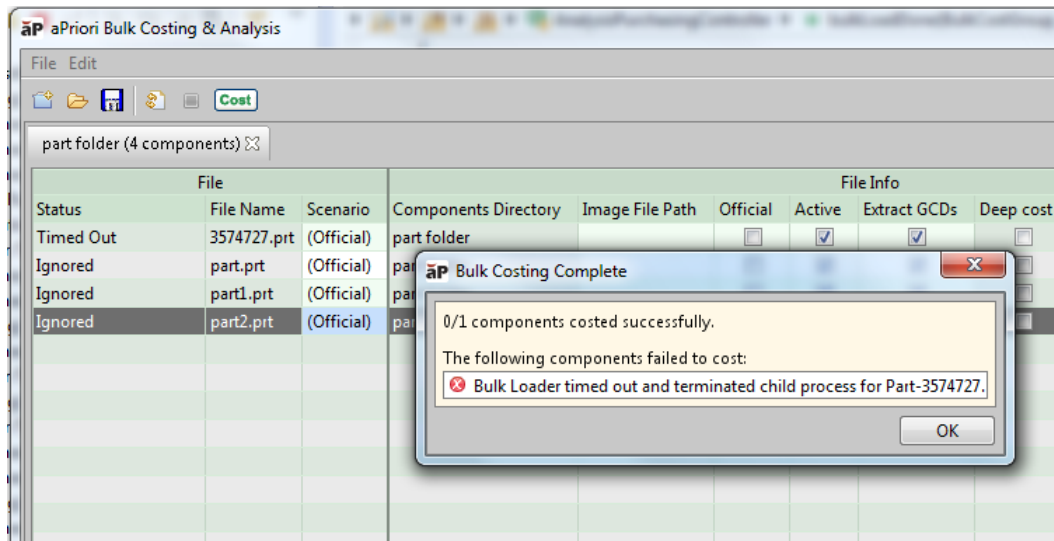
## plugin.properties file

The Bulk Loader plugin.properties file is found in `install\ext\analysis-purchasing-module` and affects both command line and UI-based Bulk Costing. Although most of the settings in this properties file are documented by comments, you should only make adjustments to this file with the assistance of aPriori Customer Support.

**Note:** As of aPriori Release 2015 R1, `bulkload.batch.size` has a new default value of "50" instead of "0", and is used in the following calculation to ensure that child processes cannot cause the parent bulk load process to hang:

**maxBatchSize \* launcher.cost.timeout.seconds + 15 mins**

If this value is exceeded, the parent bulk loader process can kill any child process. If this occurs, aPriori notifies you with a message similar to:



You can uncomment `bulkload.batch.size` and set it to a positive value. "0" is no longer supported.

Also note that as of aPriori 2015 R1 SP1, the Bulk Loader `plugin.properties` file contains a new property named `bulkload.rmi.port` (default value "1099") This is a unique port number that the Bulk Loader uses to communicate with its children processes. Don't change it unless you are running two instances of Bulk Loader concurrently on the same machine, or the default port (1099) is already in use. You can also control cache cleaning behavior from this file. See the note in the table "Summary of aPriori Properties" in the *System Administration Guide* for more info.

## Running as a Scheduled Task

If you want to run Bulk Costing and Analysis as a Microsoft Windows scheduled task (via the Windows Task Scheduler), then the task must be defined using one of the following options:

- **Run only when the user is logged on**
- **Run whether user is logged on or not** – If you choose this option, you must specify the domain user's credentials and uncheck the "Do not store password. The task will only have access to local computer resources box." The Bulk Costing and Analysis task will not run if you check the checkbox.

You can invoke the Bulk Costing module using Windows command scripts to enable "lights out" automated costing of a batch of parts. For example, you may want a workflow that supports automated costing of all parts that meet specific criteria. Contact aPriori Support or Professional Services for more information.

## Bulk Costing Usage Reports (System Admins)

The Bulk Costing and Analysis module provides a script-based Bulk Costing Usage Report to help you analyze how Bulk Costing and Analysis is being used within your organization.

**Note:** This section is intended primarily for aPriori System Administrators. You must have write permission to the aPriori installation to configure and run these reports.

The Bulk Costing Usage Report captures Bulk Cost Events, whether they were initiated through the Bulk Costing & Analysis user interface (via the **Tools > Bulk Costing and Analysis** menu item) or through the command-line script (see [Running from the Command Line](#)). The report also includes Cost Events which are the *total* number of cost events generated through the aPriori Windows Client UI and the Bulk Costing & Analysis module.

Bulk Cost Events, Cost Events and the number of Scenarios created are tracked by end-user license.

#### Notes:

- Your company needs to be licensed to use the Bulk Costing and Analysis module.
- The final count of various events will not be saved until you exit aPriori. For example, if you bulk cost 24 parts and immediately run a usage report, you might see only 20 bulk cost events recorded. If you exit aPriori and then rerun the report, you will see all 24 bulk cost events reported,

This report is intended for tracking Bulk Costing usage. For general usage tracking to guide and monitor a deployment, aPriori recommends that you use the Scenario Activity and Usage Report available in aPriori Cost Insight. These dashboards and reports have more detail on costing activity, including costing trends over time, details on specific components cost and the materials, VPEs, process groups and processes used in costing activity. For more information, see the chapter on “Scenario Activity and Usage Reports” in the *Cost Insight Guide*.

The Bulk Costing Usage Report is run as a command line script, not through the aPriori user interface. There are actually two versions of this script, which both reside in the aPriori installation directory (`<aP_install>\bin`):

- `createUsageReport.cmd` - An editable version intended to be run manually.
- `createUsageReportCmdLineArgs.cmd` - A version intended to be run from another script or as a scheduled task which passes in arguments at run-time.

The two scripts are mostly identical except that the following settings are configured to accept command line arguments in `createUsageReportCmdLineArgs.cmd` :

- `set startDate=%1`
- `set endDate=%2`
- `set onlyRecordsAfterLastReport=%3`
- `set usageReportPath=%~f4`

By default, these scripts create reports in `<aP_install>\UsageReports`.

The rest of this section assumes that you are working with `createUsageReport.cmd`.

**Note:** This report only includes Bulk Costing events that are generated using aPriori 2016 R2 or higher. Prior releases of aPriori tracked Cost Events, but did not track Bulk Costing events, so there is no data about them available for reporting purposes.

## To configure and run createUsageReport.cmd

- 1 Navigate to `<aP_install>\bin`
- 2 Open `createUsageReport.cmd` in a text editor.
- 3 **To run the Usage Report for a specified timeframe** --Set `startDate` and `endDate` values in the form MM/DD/YYYY and make sure `onlyRecordsAfterLastReport` is set to false.

**To run the Usage Report for costing activity since the time the report was generated** -- Leave `startDate` and `endDate` blank and set `onlyRecordsAfterLastReport` to true.

Save the file when done.

- 4 Double-click `createUsageReport.cmd` to run the report.

The resulting report is created and saved by default in `<aP_install>\UsageReports`. (You can specify a different target by editing `usageReportPath` in the `.cmd` file.)

## Understanding cost failures during bulk costing

If any components failed to cost during your Bulk Costing session, aPriori will still create an “empty” cost component in the aPriori database that is mapped to that CAD model, but it will not contain actual geometric or cost information. Also, aPriori does provide a message window at the end of the Bulk Costing session which lists these components and a brief description of the costing issues for each. In some cases, these descriptions are abbreviated and there are additional ways to get more information about the cause of the failure.

You can use the following approaches for investigating and handling costing failures after bulk costing:

- Look in the resulting rollup. Components that failed to cost will be displayed with a red X icon in the Status column.
- If you open a cost component and all the fields on the Cost Summary or Part/Assembly Details tab are null (a dash is displayed instead of numeric values), this typically means that no geometry information was extracted, and no costing occurred.
- In some cases, it may help to first Delete the aPriori cost component from the aPriori database (using the Tools/Delete Components menu item), and then cost that single component individually using the main aPriori application instead of the Bulk Costing and Analysis module. For certain situations, better error messages are displayed that will help you diagnose geometry issues. The main aPriori application can also detect situations in which NX assemblies are modeled within a single “part” file and handle it as a part rather than an assembly. After individually costing problematic components, you can add them to a rollup if needed.



## Improving performance

To improve bulk costing performance, you (or your administrator) can experiment with different values for "bulkload.concurrent.loader.count=1" in the following properties file:

```
<apriori_install> ext\analysis-purchasing-module\plugin.properties
```

This controls the number of concurrent bulk load threads that aPriori will support. The value is limited by the number of CPUs (or CPU cores) that your computer has. If you specify more threads than CPUs, then the extra threads will simply wait for the other processes to complete, before running, and you won't see any additional performance benefit. Each thread by default will consume an additional 2 GB of memory, so carefully balance any performance gains against the load on your system.

# 11 Spreadsheet Reports

This section describes the reporting capabilities of aPriori.

---

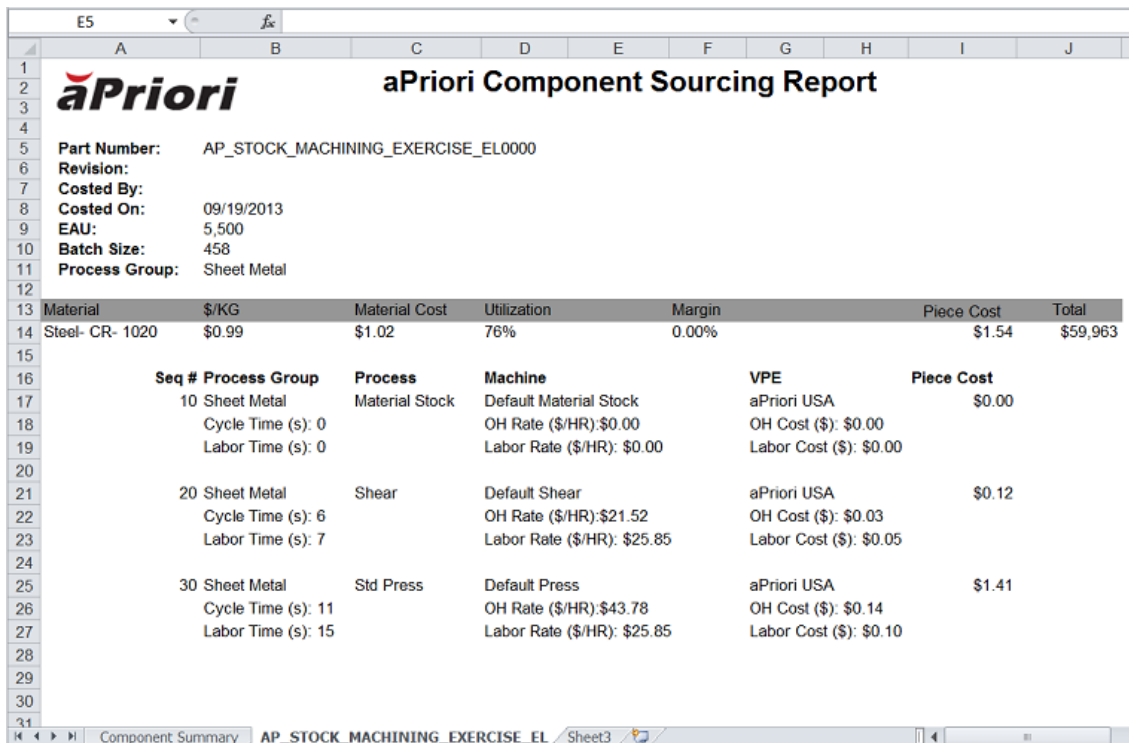
This chapter includes the following topics:

- Introduction to aPriori Spreadsheet Reports
  - Excel and Google Sheets Compatibility
  - When to Use Spreadsheet Reports
  - System-Defined Spreadsheet Reports
  - Custom Spreadsheet Reports
  - Defining What You Want to Do
  - Elements of Report Files
  - PivotTables
  - Installing and Running Custom Reports
  - Running from the Command Line
  - Troubleshooting FAQ
  - XML Configuration File Reference
-

# Introduction to aPriori Spreadsheet Reports

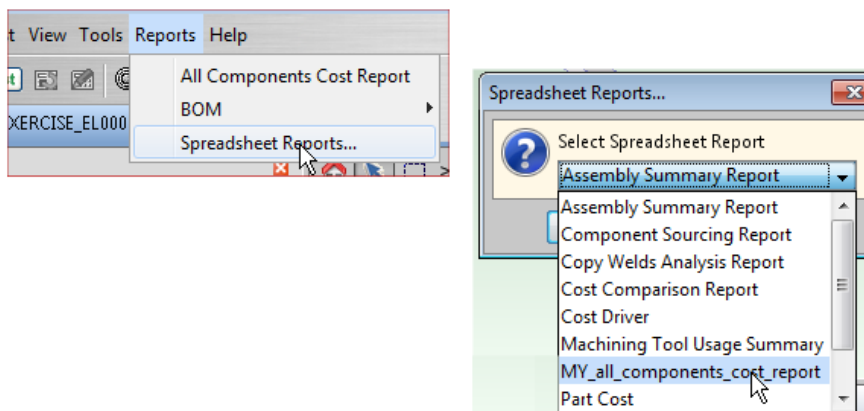
aPriori spreadsheet reports extract data from a scenario (part, assembly or rollup), and present it in an Excel spreadsheet.

You can also generate XML and CSV (comma-separated value) output. aPriori provides a number of predefined reports from the **Reports>Spreadsheet Reports** menu option. An example of one of those predefined reports, the Component Sourcing Report, can be seen below.

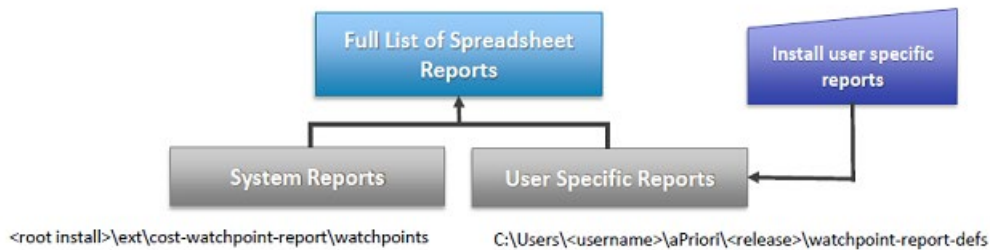


Material	\$/KG	Material Cost	Utilization	Margin	Piece Cost	Total
Steel- CR- 1020	\$0.99	\$1.02	76%	0.00%	\$1.54	\$59,963
Seq #	Process Group	Process	Machine	VPE	Piece Cost	
10	Sheet Metal	Material Stock	Default Material Stock	aPriori USA	\$0.00	
	Cycle Time (s): 0		OH Rate (\$/HR):\$0.00	OH Cost (\$): \$0.00		
	Labor Time (s): 0		Labor Rate (\$/HR): \$0.00	Labor Cost (\$): \$0.00		
20	Sheet Metal	Shear	Default Shear	aPriori USA	\$0.12	
	Cycle Time (s): 6		OH Rate (\$/HR):\$21.52	OH Cost (\$): \$0.03		
	Labor Time (s): 7		Labor Rate (\$/HR): \$25.85	Labor Cost (\$): \$0.05		
30	Sheet Metal	Std Press	Default Press	aPriori USA	\$1.41	
	Cycle Time (s): 11		OH Rate (\$/HR):\$43.78	OH Cost (\$): \$0.14		
	Labor Time (s): 15		Labor Rate (\$/HR): \$25.85	Labor Cost (\$): \$0.10		

You can also define your own custom reports.



Custom reports are available from the same menu as the system-defined reports.



You typically run these reports from the aPriori User Interface (UI), but you can also run them from the Command Line Interface (CLI). See "Running from the Command Line" on page 336.

**Note:** aPriori uses an internal "watchpoint" mechanism to generate spreadsheet reports and populate them with variable and attribute values. This is why you will occasionally see this term when using report functionality. However, aPriori watchpoints have no relation to watchpoints that are used in conjunction with some debuggers.

## Excel and Google Sheets Compatibility

In general, you should use a recent version of Microsoft Excel when working with Spreadsheet reports, and when creating custom reports with templates, you should use the same version of Excel for both creating and viewing the template. Check the System Requirements document for the version of Excel that aPriori has tested Spreadsheet Reports against (as of this writing, we have tested against Excel 2010).

With the exception of the Component Sourcing report, all aPriori report templates are .xlsx files, so if you are using Excel 2003, you should upgrade to Excel 2010 when using .xlsx-based reports.

Note that template-based reports work properly when the OS running the report supports the same version of Excel on which the spreadsheet report template is based. For example, if you build a spreadsheet report and create a template for it with Excel 2010, then you should use Excel 2010 to view it. Problems may occur when the two versions are mismatched. You should not use Excel 2007, for instance, to open a template created on Excel 2010.

It is possible to view aPriori Spreadsheet reports in Google Sheets, however you may need to unhide tabs that are hidden in the reports. If you open a report in Google Sheets and the display looks incomplete or incorrect, try the following workaround:

- 1 Open the report in Excel.
- 2 Right-click on the tabs and unhide them.
- 3 Import into Google Docs

## When to Use Spreadsheet Reports

Generating reports as Excel spreadsheets can be convenient when you wish to share your data with other programs or organizations. Some aPriori customers use spreadsheet reports to combine their aPriori data with a PLM (Product Lifecycle Management) system.

The ability to define your own reports and to change their format makes spreadsheet reports a very flexible tool for analyzing and exporting your aPriori data.

The ability to run spreadsheet reports from the command line also means that you can automate report generation by creating scripts that run as Windows scheduled tasks.

## System-Defined Spreadsheet Reports

When you install aPriori, you automatically have access to several pre-defined spreadsheet reports. These can be generated from the aPriori user interface or from the command line interface (see *Installing and Running Custom Reports* and *Running from the Command Line*).

**Note:** The older PDF report feature is deprecated and no longer available as of aPriori 2015 R1. Also note that spreadsheet reports now support foreign currencies.

The following reports are available:

Report	Description
Assembly Summary Report	Summarize the current part and process costs associated with the active assembly.
Component Sourcing Report	The Component Sourcing report makes it easy to compare aPriori cost estimates with supplier quotes. The report is available for parts and assemblies and provides manufacturing and cost information for each process in the selected manufacturing routing as well as for the whole component.
Copy Welds Analysis Report	Use this report to determine the success of a <b>Copy Welds From..</b> operation (see Virtual welds). This report is automatically generated when you perform the copy, and you can also generate it from scratch from this menu. As with other reports, the data of most interest is found on the first tab ("Weld Diagnosis"). The other tabs contain raw data that is used to compile the diagnosis tab. Imported virtual welds retain the same weld IDs that they had in the source assembly. Any existing virtual welds in the destination assembly are discarded. Any CAD-defined (non-virtual) welds have IDs that start after the imported IDs so that they appear at the end of the weld list.
Cost Comparison Report	Compares the current costs for the parts, part scenarios, assemblies, and roll-ups included in the active comparison

Cost Driver	The Cost Driver report applies to parts or assemblies and contains several charts that provide insight into which types of costs dominate the overall cost and which processes and features (GCDs) are the most time-consuming and therefore costly.
Machining Tool Usage Summary	Provides a summary of the tools and their properties used to machine a part.
Part Cost	The Part Cost report shows the current cost of the processes associated with manufacturing the active part
Roll-up Summary Report	Compares the current costs for the parts, part scenarios, assemblies, and roll-ups included in the active roll-up
Tooling Report	<p>The Tooling report applies to parts and presents tooling cost and tooling manufacturing detail breakdowns for the following process groups:</p> <ul style="list-style-type: none"> <li>• Injection Molding</li> <li>• Progressive Die</li> <li>• Tandem Die</li> <li>• Transfer Die</li> <li>• Stage Tooling</li> </ul> <p>All available process tooling reports are available as separate tabs in the same Tooling Report.</p>
All Components Cost Report	<p>Generates an Excel file which includes a row of information about all the cost components in the aPriori database.</p> <p><b>Note:</b> This report is generated differently than the other spreadsheet reports, and has the following unique characteristics:</p> <ul style="list-style-type: none"> <li>• You must be an aPriori administrator to run this report</li> <li>• It has its own <b>Reports</b> menu item. It is not found under the <b>Spreadsheet Reports</b> menu item.</li> </ul>

**Note:** To accommodate components with extensive data, some reports reserve a minimum number of pages for the report summary. For smaller components, some of these pages may be marked with "This page intentionally left blank". You can delete any such pages after the report has been generated.

### To generate a spreadsheet report from the UI

- 1 Open a part, assembly, cost comparison, or roll-up in aPriori.
- 2 Click **Reports > Spreadsheet Reports**.
- 3 Select the report type from the drop-down menu. Click **OK**.

**Note:** You can run any report on any component, even if it is not logical. For example, you can run an Assembly Summary Report on an open part, but aPriori will flag the error in the summary block at the top of the report with a message in red such as "This report is only intended to be run on an assembly, this is a part".

- 4 If necessary, edit the default values for the folder and file name for saving the report, and click **Save**.
- 5 Click **Yes** to view the report or **No** to close the window without viewing the report.

## Custom Spreadsheet Reports

In addition to using aPriori's system-defined spreadsheet reports, you can define your own. It is often desirable to use existing, system-defined reports as your starting point.

The system-defined report XML files reside in:

```
apriori_install\ext\cost-watchpoint-report\watchpoints\  
reportname.watchpoints.xml
```

The corresponding Excel template files resides in:

```
apriori_install\ext\cost-watchpoint-report\watchpoints\templates\  
reportname.template.xls
```

### File types

The typical spreadsheet report consists of an XML file defining the data to extract, and optionally, an Excel spreadsheet template file which determines how the output will be formatted. To install a new custom report in aPriori, you can either:

- Compress these files into a .zip file and install it with **Tools>Spreadsheet Reports>Install Spreadsheet Reports**
- Simply copy the files into `user\apriori\version\watchpoint-report-defs`

The output files will be either an Excel spreadsheet, or a comma-separated values (CSV) file, or an XML file.

### Report Definition Files

**.xml** -- Required. Specifies what data to extract from aPriori. Name **MUST** end in ".watchpoints.xml" or the report will be ignored when you try to run it from the UI (the restriction is not enforced when running from the command line).

**.xls (or .xlsx or .xlsm)** -- Optional. Specifies how to format the data. The convention used by **Tools>Spreadsheet Reports>Install Spreadsheet Reports** is to end the name in ".template.xls", and to place this file in a "template" sub-folder under the reports (.xml) folder. The template file must be specified with the templatePath attribute to the <report> tag in the .xml file, or it will be ignored.

**.zip** -- The .xml file and the .xls (if defined) must be bundled into a .zip file to be recognized by the aPriori **Tools>Spreadsheet Reports>Install Spreadsheet Reports** command.

## Report Output Files

**.xls (or .xlsx or .xlsm)** -- The default spreadsheet output file.

**.csv** -- A text output file containing comma-separated values. (Specified with a `generateCsv="true"` attribute to the `<reports>` tag in the XML definition file.

**.xml** -- A text output file containing XML. (Specified with a `generateXml="true"` attribute to the `<reports>` tag in the XML definition file.

For more information about the `<report>` tag and its attributes, See "*Elements of Report Files*" on page 324.

**Note:** Custom reports are installed locally and are only available to the user who installs them. They are not available to other users even though they may share the same aPriori database server.

## Workflow

The typical workflow for defining and running such custom reports is:

- 1 Create an `.xml` file to return the results you want (see "Creating a Custom Spreadsheet Report" below). Optionally define an Excel `.xls` file to format the data the way you want. In the `.xml` file, make sure to define the `<report>` tag `"templatePath"` attribute to point to the current `.xls` file).
- 2 Install the new report, either by copying the files to `user\apriori\version\watchpoint-report-defs`, or by creating a `.zip` file from the modified `.xml` and `.xls` files and using **Tools>Spreadsheet Reports>Install Spreadsheet Reports**. (Copying a new report for the first time requires restarting aPriori; subsequent update copies do not.)
- 3 Run the report with **Reports>Spreadsheet Reports**

Note that you can also choose to run the custom report (or any system-defined report) from the command line. If you will always be running this report from the command line and never using it from the UI, you can skip the last two steps and generate the reports as described in See "Running from the Command Line" on page 336.

When you install your custom reports, they reside in your local aPriori user folder, such as:

```
C:\Users\myUserName\apriori\14.1\watchpoint-report-defs
```

They are NOT added to the aPriori system-defined reports in `apriori_install\ext\cost-watchpoint-report\watchpoints`

## Creating a Custom Spreadsheet Report

When first starting with aPriori spreadsheet reports, it is best to begin with the simple snippets based on the samples shown in this document at the See "Elements of Report Files" on page 324 The system-defined spreadsheet report files that are installed as part of aPriori may contain advanced features that are not meant to be used for custom reports, and which are not documented.



## Defining What You Want to Do

As with any coding activity, you should have a clear idea of what you want to accomplish with your custom report. If you simply want to re-format data that is presented in the UI, then you will probably focus on setting up the template Excel file so that it presents the data the way you want it.

If you simply want to extract a handful of values that are not available in a single UI screen, and do not care much about the appearance of the data, you, may not even define a spreadsheet format file; just define a simple XML file that extracts the data you want and dumps the raw data into a new .xls file.

If you are looking for an automated status report that runs every night, you will probably focus on extracting the data you are most interested in and executing the report generation from a command line script that kicks off as a Windows scheduled task.

If you are looking to generate a common-format quoting report, you might start by identifying the quantities and expected costs for various models that can be presented in a uniform way, and also spend time with the Excel format to ensure that presents the data in a professional and intuitive way.

Will your report require graphs? Plan to spend some time in the Excel template defining that graphics you want to include.

Regardless of what specific purpose your report will serve, spend some time up front defining what you want it to do.

## Editing XML Files

aPriori suggests that you use a text editor such as Notepad++ that provides contextual highlighting for editing XML files.

## Complexity

Part of this evaluation process should consider the complexity of the report you want to create. Here are some factors to consider:

Spreadsheet:

- Easy -- Raw formatting
- Medium -- Basic formatting
- More difficult -- Charts, PivotTables®, graphics

Type of data:

- Easy -- Part level
- Medium -- Process and Operation Level
- More difficult -- GCD Level

Availability of data:

- Easy -- Already available as output in UI
- Medium -- Can be calculated from available output
- More difficult -- Needs to be custom-defined (probably for multiple processes)

**Note:** In general, if you can see it in the UI, you can access it for a spreadsheet report. However, you may encounter situations where this is not true. If you do run into this situation, please file a support ticket explaining what variable you cannot access from XML that you can see in the UI.

## To Generate XML or CSV Files

If you want to generate XML or CSV (comma-separated values) files rather than a .xls spreadsheet, see the attributes for the `<reports>` tag as described at "`<reports>`" on page 342.

# Elements of Report Files

A typical aPriori spreadsheet report consists of:

- an XML (.xml) file that defines the data to be extracted from aPriori.
- an optional Excel template file (.xls or .xlsx or .xlsm) that defines how the data should be formatted.
- an Excel output file containing the extracted data (the actual "report").

Note that if no Excel template file exists, then the data will be dumped into the Excel output file with no formatting. For small reports, this may be sufficient. But more likely you will need to format the data with a template file to make the report usable.

You can format your spreadsheet report with Excel PivotTables® for advanced formatting. And you can choose not to create a spreadsheet at all and instead dump out your data into a CSV (comma-separated values) file or an XML file.

The data that you can extract from aPriori are generally variables that are defined as part of the aPriori software, or defined by a VPE creator as a custom output.

## Basic Structure of the XML File

The following section gives a high-level overview of the contents of a typical aPriori spreadsheet report XML file. For more detailed information, see the XML Reference section starting at "*XML Configuration File Reference*" on page 340.

```
<?xml version="1.0" encoding="utf-8"?>
  <reports templatePath="templates/costdriver.report.template.xls"
    traverseAssemblies="true">
    <CostModelWatchpoints sheetName="apOutput">
    </CostModelWatchpoints>
    ...
    <CostModelWatchpoints>...</CostModelWatchPoints>
  </reports>
```

A `<reports>` tag can contain any number of `<CostModelWatchPoints>` tags, each of which represents a logical group of data to be generated. In the case of the data going to Excel, each `<CostModelWatchpoints>` section generates data to a single worksheet (named by the 'sheetName' attribute). For example:

```
<CostModelWatchpoints sheetName="apOutput">
  <Node name="*" isLeaf="true" suppressZeros="false" tag="first">
```

```

<CSL>
  <Formula>materialCost</Formula>
  <Formula>laborCost</Formula>
  <Formula>directOverheadCost</Formula>
  <Formula>setupCostPerPart</Formula>
  <Formula>expendableToolingCostPerPart</Formula>
  <Formula>targetCost</Formula>
</CSL>
</Node>
</CostModelWatchpoints>
    
```

## The <reports> Tag

( See "<reports>" on page 342 for a detailed reference.)

Outputs data for all subcomponents

```

<reports traverseAssemblies="true" templatePath="templates\asa-template.xls">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true" hasChildren="false" revisitScenarios="true" generateOne
  <Node name="*" suppressZeros="false">
    <CSL getAllFormulas="false" getAllFunctions="false">
      <Formula>costed</Formula>
      <Formula>uncosted</Formula>
      <Formula>userDefined</Formula>
      <Formula>initialized</Formula>
      <Formula>manuallyCosted</Formula>
      <Formula>laborRate</Formula>
      <Formula>machineName</Formula>
      <Formula>overheadRate</Formula>
      <Formula>costedByUserFullName</Formula>
      <Formula>costedByUserID</Formula>
      <Macro Heading="costPerKG">${materialCost}/${roughMass}</Macro>
      <Macro Heading="numOperators">IF({laborTime}>0,${laborTime}/${cycleTime},0)</Macro>
      <Macro Heading="roughMassDisplay">IF({roughMass}=0,${finishMass},${roughMass})</Macro>
      <Macro Heading="costStatus">IF({Level} = "component",IF({initialized} = TRUE,IF({manuallyCosted} =
    <Formula> partNumber </Formula>
    <Formula> materialUnitCost </Formula>
    
```

## The <CostModelWatchPoints> Tag

(See "<CostModelWatchpoints>" on page 343 for a detailed reference.)

Output Tab name in Excel

Prints for processes and component-level

Do not filter out duplicate visits to scenarios.

Print in rows

Do not print a row for the rollup itself

```
<?xml version="1.0" encoding="utf-8"?>
<reports traverseAssemblies="true" templatePath="templates\asa-template.xls">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true" hasChildren="false" revisitScenarios="true" generateOneRowPerAttribute="false" suppressRollups="true">
    <Node name="*" suppressZeros="false">
      <CSL getAllFormulas="false" getAllFunctions="false">
        <Formula>costed</Formula>
        <Formula>uncosted</Formula>
        <Formula>userDefined</Formula>
        <Formula>initialized</Formula>
        <Formula>manuallyCosted</Formula>
        <Formula>laborRate</Formula>
        <Formula>machineName</Formula>
        <Formula>overheadRate</Formula>
        <Formula>costedByUserName</Formula>
        <Formula>costedByUserID</Formula>
        <Macro Heading="costPerRO">${materialCost}/${roughMass}</Macro>
        <Macro Heading="numOperators">IF (${laborTime}>0, ${laborTime}/${cycleTime},0)</Macro>
        <Macro Heading="roughMasDisplay">IF (${roughMass}=0, ${finishMass}, ${roughMass})</Macro>
        <Macro Heading="costStatus">IF (${Level} = "component", IF (${initialized} = TRUE, IF (${manuallyCosted} = FALSE, "aPriori", "Manual"), "Uninitialized"), "")</Macro>
        <Formula> partNumber </Formula>
      </CSL>
    </Node>
  </CostModelWatchpoints>
</reports>
```

## The <node> Tag

(See "<node>" on page 345 for a detailed reference.)

Name of node (equivalent to nodes in the routing editor)

Use \* to get all nodes

Do not skip empty nodes

```
<?xml version="1.0" encoding="utf-8"?>
<reports traverseAssemblies="true" templatePath="templates\asa-template.xls">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true" hasChildren="false" revisitScenarios="true" generateOneRowPerAttribute="false" suppressRollups="true">
    <Node name="*" suppressZeros="false">
      <CSL getAllFormulas="false" getAllFunctions="false">
        <Formula>costed</Formula>
        <Formula>uncosted</Formula>
        <Formula>userDefined</Formula>
        <Formula>initialized</Formula>
        <Formula>manuallyCosted</Formula>
      </CSL>
    </Node>
  </CostModelWatchpoints>
</reports>
```

## The <CSL> Tag

(See "<CSL>" on page 345 for a detailed reference.)

## Do not print all formulas and functions (recommended)

```

<?xml version="1.0" encoding="utf-8"?>
<reports traverseAssemblies="true" templatePath="templates\ASA-template.xls">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true" hasChildren="false" revisitScenarios="true" generateOneRowPerAttribute="false" suppressRollups="true" >
    <Node name="*" suppressErrors="false">
      <CSL getAllFormulas="false" getAllFunctions="false">
        <Formula>costed</Formula>
        <Formula>uncosted</Formula>
        <Formula>userDefined</Formula>
        <Formula>initialized</Formula>
      </CSL>
    </Node>
  </CostModelWatchpoints>
</reports>
    
```

## The <Formula> and <Macro> Tags

(See "<Formula>" on page 346 and <MACRO> for a detailed reference.)

<p>Formula names</p>	<p>&lt;Macro&gt; tag</p> <p>Heading = name of column; cannot match a formula name</p> <p>Provide a calculation. Refer to other variables using <code>#{variableName}</code> syntax</p> <p><b>Best practice:</b> Do all static-data calculations using the &lt;Macro&gt; tag</p>
----------------------	---

```

<?xml version="1.0" encoding="utf-8"?>
<reports traverseAssemblies="true" templatePath="templates\ASA-template.xls">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true" hasChildren="false" revisitScenarios="true" generateOneRowPerAttribute="false" suppressRollups="true" >
    <Node name="*" suppressErrors="false">
      <CSL getAllFormulas="false" getAllFunctions="false">
        <Formula>costed</Formula>
        <Formula>uncosted</Formula>
        <Formula>userDefined</Formula>
        <Formula>initialized</Formula>
        <Formula>manuallyCosted</Formula>
        <Formula>laborRate</Formula>
        <Formula>machineName</Formula>
        <Formula>overheadRate</Formula>
        <Formula>costedByUserFullName</Formula>
        <Formula>costedByUserID</Formula>
        <Macro Heading="costPerRO">#{materialCost}/#{roughMass}</Macro>
        <Macro Heading="numOperators">IF(#{laborTime}>0,#{laborTime}/#{cycleTime},0)</Macro>
        <Macro Heading="roughMassDisplay">IF(#{roughMass}=0,#{finishMass},#{roughMass})</Macro>
        <Macro Heading="costStatus">IF(#{level} = "component",IF(#{initialized} = TRUE,IF(#{manuallyCosted} = FALSE,"aPriori","Manual"),"Uninitialized"),"")</Macro>
      </CSL>
    </Node>
  </CostModelWatchpoints>
</reports>
    
```

## Commonly Used Variables

Here are some commonly used variables that can get you started.

For all components:

- calculationDate
- costedByUserFullName
- selectedRoutingName – removes unnecessary optional-but-unused process names
- displayName – shows process name correctly for User Defined Processes

For parts

- materialName
- materialStockName
- materialUnitCost – shows actual unit cost used in material calculation

For assembly sub-components

- parentScenario
- countInParent
- “aggregates” = (individual value) x countInParent

Note that this provides only the count for the current BOM depth. If you have the same part in multiple depths of the BOM, it will not output the total count in all BOM levels as one value, but rather it will be a value for each level.

## Built-in Aggregation, Quoted Cost and other Formulas/Attributes

The following formulas/attributes are available for components, assemblies and rollups.

For the aggregation attributes, consider the following example: Assembly1 consists of 3 parts: 2 instances of Part A and one instance of Part B. Within Assembly1, "countInParent" of Part A is 2 and of Part B is 1.

Now suppose that there is another assembly, Assembly2, that contains 2 instances of Assembly1. For Assembly1, in the context of Assembly 2, "countInParent" is still 2. The values of "countInParent" for parts A and B are the same as well.

The following attributes are available at any level. You should use some subset of these if you set "generateStandardColumns" to false:

- gcdType
- gcdName
- processName
- nodeName
- processGroupName
- partNumber
- scenarioType
- scenarioName
- vpeName

Costs and weights work the same way as counts. So "aggregateCostInParent" for a given part is (fullyBurdenedCost + costOfChildScenarios)\* countInParent.

Note that "aggregateCost..." (and by extension "aggregateFinishMass") includes the (aggregate) cost of child scenarios for rollups and assemblies. Logically, the cost of child scenarios for mere parts is 0.

Below is a list of the aggregated attributes:

- parentScenario
- parentScenarioType
- countInParent
- aggregateCost (aggregateFullyBurdenedCost)
- aggregateCostInParent
- costOfChildScenarios

- aggregateFinishMass
- aggregateFinishMassInParent
- finishMassOfChildScenarios
- aggregateFullyBurdenedCost
- aggregatePiecePartCost
- aggregateToolingCostPerPart (ammortized tooling)
- aggregateFixtureCostPerPart
- aggregateProgrammingCostPerPart
- aggregateAdditionalDirectCosts
- aggregateExtraCosts
- aggregateMaterialCost
- aggregateOverheadCost
- aggregateLogisticsCost
- aggregateLaborCost
- aggregateLaborTime

Non ammortized aggregates:

- aggregateCapitalInvestment
- aggregateHardToolingcost
- aggregateFixtureCost
- aggregateProgrammingCost

## User Defined Attributes

User-defined attributes are accessible directly. That is, a custom (or user-defined attribute) called "owner" would be accessible as "customAttributes.owner"

## Using the <Macro> Tag

Use the Macro tag to generate formulas that will run in Excel. Only the subset of formulas supported by Apache POI is supported (see <http://poi.apache.org/spreadsheet/formula.html>).

Example:

```
<Macro Heading="bob">${fullyBurdenedCost}*${countInParent}</Macro>
```

This will generate a column called "bob" that for each generated row contains the Excel formula "=\$R1\$C1 + \$R1Rc2", where:

- R1 is the value of the current row
- C1 is the column name where fullyBurdened cost landed
- C2 is the column where countInParent landed.

This assumes that you have specified that the report generator should generate these two columns within the same <CSL> tag. Note that the name that you use for a column should be the name of the Heading attribute if there is one.

Other available syntax:

- `${^<colHeading>}` refers to the <colHeading> cell in the previous row (will map to 0 if this is the first row)
- `${.<colHeading>}` refers to the <colHeading> cell in the first row
- `${@<colHeading>}` refers to the column (the entire column)

In addition, the report generator creates a named range that maps to the data values (it excludes the header row) for each column with the column header name. You can just refer to that name in your formula macro.

**Note:** If a non-existent column is referenced in a macro formula, the value "0" is substituted. A non-existent column can occur if you have a Macro spec that references columns for which the current "Node/CSL" elements have as yet generated no rows. For example, assume that your Node spec is looking for all leaf nodes, only some of which have the custom output "foo". If you use "foo" in a macro formula, there will be no column for "foo" in the output spreadsheet until we actually hit a node that causes us to create one.

## Figuring Out What Variables to Use

aPriori spreadsheet reports provide access to so many formulas and functions that it can be difficult to know what variable name to call for a particular value. These also tend to change from release to release, so any attempt to maintain a static reference list would quickly become obsolete. The most practical way to find the formula value that you want to use is to run a report that returns ALL formulas and functions. If necessary to identify the variable name for a specific value, you can temporarily set the value to something unique, run the report, search the report for that unique value, and identify the column under which it appears.

Here is an example of a report that will return all formulas and functions for a given part.

**Note:** This report can take a long time to execute if run against a large, complex part, or against many parts. Experiment with small parts first. Also, the report can return so many columns that Excel may display an "Unreadable content" error message when you open the spreadsheet. This error can be ignored.

Also note the "templatePath" specifier in the <reports> tag. You easily can create a blank template file by saving an empty Excel spreadsheet as an .xslm file. (For the purposes of this exercise, you don't need a real template.) Make sure that you save this blank template file in the specified folder, and that the name of the file exactly matches the name specified in the templatePath.

```
<?xml version="1.0" encoding="utf-8"?>
<reports traverseAssemblies="true" templatePath="templates\All aPriori
Variables-template.xslm">
  <CostModelWatchpoints sheetName="ap_output" isLeaf="true"
hasChildren="false" revisitScenarios="true"
generateOneRowPerAttribute="false" suppressRollups="false" >
    <Node name="*" suppressZeros="false">
```



```

        <CSL getAllFormulas="true" getAllFunctions="true">
          </CSL>
        </Node>
      </CostModelWatchpoints>
    </reports>

```

## Including part images and nesting diagrams in your report

You can include thumbnail images of parts, and (if available), nesting diagrams, in your reports, by adding the following attribute to the **<Reports>** tag in the XML file:

```
generateThumbnails="true"
```

In Excel, this will create:

- a new tab called "Thumbnails" containing the images
- a table in the cost summary sheet containing the mapping from the scenario name to the name of the image in Excel.

In XML output, the **<Scenario>** element will have a "thumbnail" attribute with a reference to a .png file, which gets generated in the same directory as the XML.

In CSV, we generate the .png files in the same directory as the .csv files. There is no reference in the CSV output to the .png files.

## Including information about scenario overrides

As of aPriori Professional Release 2018 R1, you can now include information about scenario overrides in your spreadsheet reports. (For information about overrides, see [Overriding computed values](#) in Chapter 5.)

To do this, you must:

- Extend the scope of the data included in the report to include override data.
  - Format the data as desired.
- 1 Add the following commands to the report's XML file to include the user override data and specify the worksheet where data will be output.

```

generateUserOverrides="true"
overridesSheetName="<sheet name>"

```

- 2 Modify the report's Excel template file to format and display the override information as desired. The override outputs will be generated in a standard format that can easily be processed using a pivot table (see the next section) to simplify formatting.

**Note:** This capability is currently available only for custom spreadsheet reports. The standard spreadsheet reports that are included in the out-of-the-box aPriori installation have not been updated to include override data..

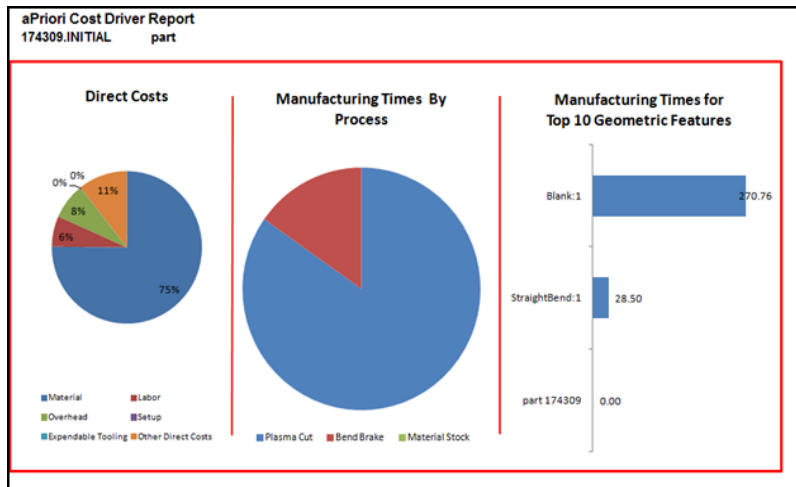
## PivotTables

One way to increase the usability of your aPriori spreadsheet reports is to enhance your Excel template files with PivotTables®. This is not an aPriori-specific topic, so this

section does not go into depth. You should go to Excel documentation for general Pivot Table information. But this section gives you an overview as to how to use PivotTables with aPriori data.

## When to use PivotTables

Consider using PivotTables when you want to create relatively simple tabular or graphical views of your aPriori data. You can also use PivotTables to filter out a certain data point (or points) from the output data worksheet.



### To Define a PivotTable Template

- 1 Create and install a spreadsheet report.
- 2 Run the spreadsheet report on actual data.
- 3 Open the output .xls file and use the **Insert>PivotTable>PivotTable** and/or **PivotChart** feature to define the range of data you want to use from the output tab.
- 4 Refer to Excel on-line help for details about defining your PivotTable and PivotChart.
- 5 Click **PivotTable Options > Data** and ensure that “**Refresh data when opening the file** is checked.
- 6 Remove the output tab and ReportSummarySheet tabs. This is now your template.
- 7 Update the templatePath of your `watchpoints.xml` file to reference the new Excel template.
- 8 Install and run the report.

### To Use a PivotTable to Filter out Data

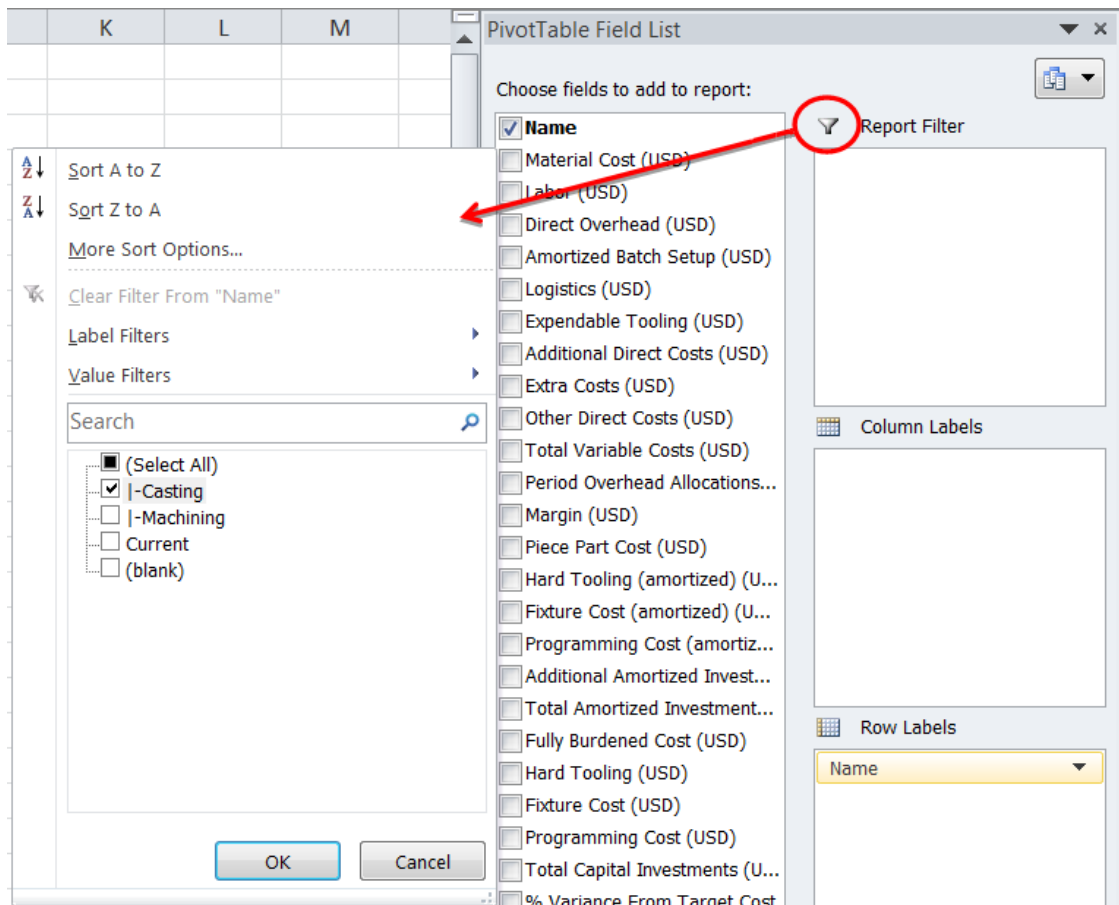
To filter the PivotTable to display the information you want, you need to select a path that, when used, will only display the information you want. For example:

- 1 Follow Steps 1 through 3 above in “To Define a PivotTable Template”.

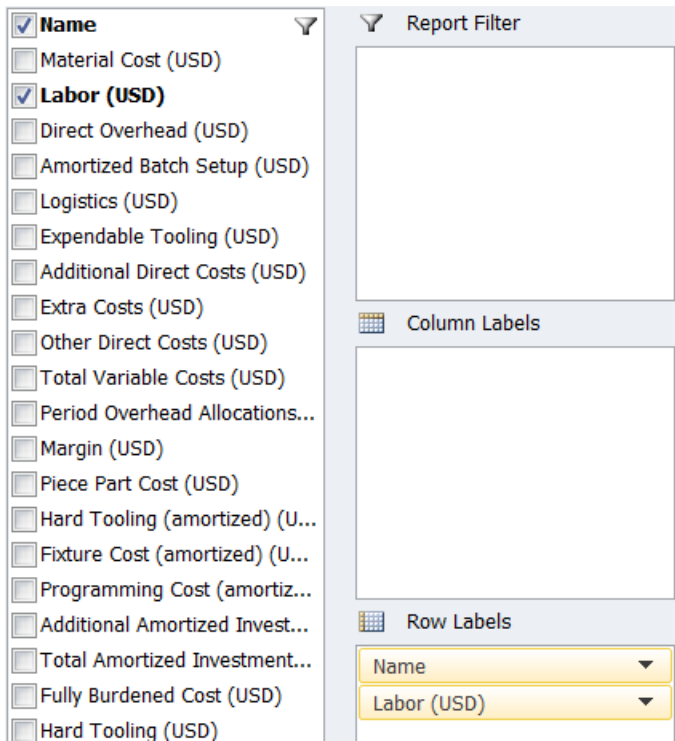
- In this case, you want to display the labor cost for the casting process in a report. Here is the data that is output when the report is run:

	A	B	C
1	Name	Material Cost (USD)	Labor (USD)
2	Current	4.575311332	0.91997351
3	-Casting	4.575311332	0.190459609
4	-Machining	0	0.7295139

- Once you create the PivotTable with **Insert>PivotTable>PivotTable**, you can then start to create the path to display the information you want. The quickest path to display labor cost for casting is to first check off the box next to “Name” in the PivotTable Field List and to filter the “Name” column to show only information for Casting:



- Check off the “Labor (USD)” box to show the labor cost for the Casting process:



5 The end result of the PivotTable should look like this:

Row Labels
[-]   -Casting
0.190459609
Grand Total

The report template can then read off of this cell for every time the report is run to then always show the labor cost for the casting process.

### Using More Filters

This same method can be used for data outputs that require as many filters as you need in order to get only the information that you want to show. Below is an example of using more filters. In this case you want to display Labor Rate for the turret press process for the part name “AP\_BRACKET\_HANGER\_EL0000.Initial”.

	D	E	F	M	X	Z
1	<b>Scenario</b>	<b>ScenarioType</b>	<b>ScenarioFullName</b>	<b>Node</b>	<b>laborRate</b>	<b>overheadRate</b>
2	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	Material Stock	0	0
3	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	Turret Press	25.8543201	39.63801978
4	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	Bend Brake	25.8543201	24.7069607
5	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	[CTL]/Turret/[Deburr]/[Bend]		
6	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	Sheet Metal		
7	Initial	part	AP_BRACKET_HANGER_EL0000.Initial	Sheet Metal/Machining		
8	Initial	part	FASTENER_EL0000.Initial	Material Stock	0	0
9	Initial	part	FASTENER_EL0000.Initial	Laser Cut	25.8543201	43.24203533
10	Initial	part	FASTENER_EL0000.Initial	[CTL]/Laser/[Bend]		
11	Initial	part	FASTENER_EL0000.Initial	Sheet Metal		
12	Initial	part	FASTENER_EL0000.Initial	Sheet Metal/Machining		
13	Initial	part	WELD_SUPPORT_EL0000.Initial	Material Stock	0	0
14	Initial	part	WELD_SUPPORT_EL0000.Initial	Turret Press	25.8543201	39.63801978
15	Initial	part	WELD_SUPPORT_EL0000.Initial	[CTL]/Turret/[Deburr]/[Bend]		
16	Initial	part	WELD_SUPPORT_EL0000.Initial	Sheet Metal		
17	Initial	part	WELD_SUPPORT_EL0000.Initial	Sheet Metal/Machining		

The red box above shows the path the PivotTable should take.

PivotTable Field List

Choose fields to add to report:

- bomLineNumber
- bomDepth
- Part Number**
- Scenario
- ScenarioType
- ScenarioFullName
- VPE
- ProcessGroup
- Process
- Level
- Leaf
- HasChildren
- Node**
- GcdType
- Gcd
- Gcd Display Name
- CostView
- Tag
- costed
- uncosted
- userDefined
- initialized
- manuallyCosted
- laborRate**

Report Filter

Column Labels

Row Labels

- Part Number
- Node
- laborRate

This filters out part numbers to show only "AP\_BRACKET\_HANGER\_EL0000.Initial"

This filters out nodes to only show "Turret Press"

After the three boxes above are checked off and the two filters are applied, the PivotTable displays only the labor rate for the turret press node for the selected part:

3			
4	Part Number	Node	laborRate
5	AP_BRACKET_HANGER_EL0000	Turret Press	25.85432014

## Installing and Running Custom Reports

Once you have defined your XML report file and (optionally) your .xls spreadsheet template file, you can install them in one of two ways:

### From the GUI

- 1 Compress them into a .zip file (typically via the Windows **Send to>Compressed (zipped) folder** command).
- 2 Install the .zip file with **Tools>Spreadsheet Reports>Install Spreadsheet Reports**.
- 3 Run the report with **Reports>Spreadsheet Reports**.

### By Copying

Copy the files to

```
C:\Users\myUserName\aPriori\version\watchpoint-report-defs
```

### Caveats

- The installer recognizes only .zip files. Within the .zip file, only files with the following extensions will be installed: .xml, .xls, .xlsx, .xlsm. Any other file will be ignored.
- Even if an XML file is successfully installed, it will not appear in the list of available reports unless the name ends in ".watchpoints.xml". A report named "report.xml" will not appear. A report named "reports.watchpoints.xml" will.
- If you try to install a custom report with the same name as an existing system-defined report, aPriori displays the error "The following reports already exist and were not installed"
- If you install a custom report with the same name as an existing custom report, aPriori overwrites the older report.

### Define a shared store (System Admins Only)

It is possible for a System Administrator to define a property so that custom spreadsheet reports are accessible by multiple users via a shared folder.

- 1 Choose a shared folder that multiple users can access, and create a subfolder there named "templates". For example:

```
F:\shared\apriori_reports\templates
```

- 4 Make sure that aPriori is not running, otherwise you might lose any changes to the properties file when you restart aPriori.
- 5 Change to the folder `C:\Users\\AppData\Local\aPriori\.`
- 6 In this folder you can make edits to one of two files:
  - `apriori.user.properties` -- (This file gets overwritten every time you exit aPriori.)
  - `apriori.system.properties` -- (This file does NOT get overwritten when you exit aPriori. This file may not already exist in this folder. If not, go ahead and create it.)

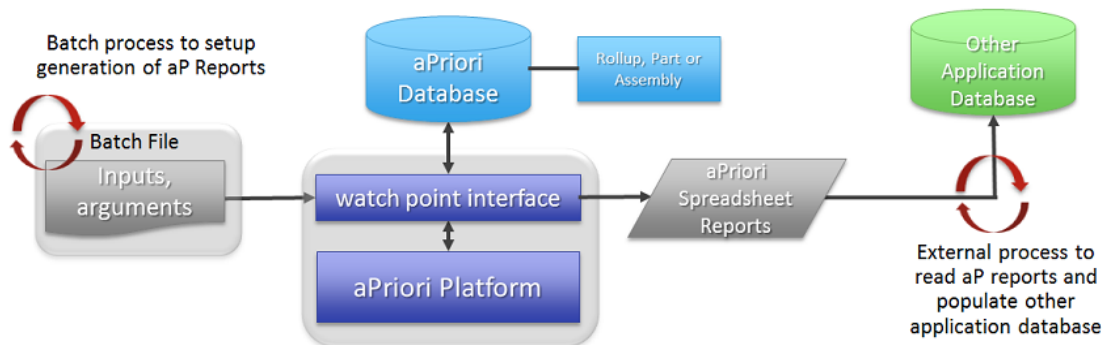
Add the following entry to file, pointing to the shared folder that you created in Step 1 above. For example:

```
apriori.watchpoint.report.dir=F:\\shared\\apriori_reports
```

Note that you must preface special characters and spaces with "\", and that you do NOT want to include the "template" sub-folder in this line.
- 7 Save the file you have just edited.
- 8 Start aPriori.
- 9 Click **Tools > Spreadsheet Reports > Install Spreadsheet Reports**.
- 10 Navigate to the .zip spreadsheet report file(s) that you wish to share and click **OK** to install them. When done, these files should exist in the shared folder you specified.
- 11 For all users who should have access to shared reports, repeat Steps 2 through 6.
- 12 For any of these users who have reports to contribute to the shared folder, ensure that they have write access to the shared folder, then repeat Steps 7 and 8.

## Running from the Command Line

You can run spreadsheet reports from the command line. This means that you can include report generation in batch scripts and create reports without needing to bring up the aPriori user interface. This can be useful for automated status reports, or automatically feeding aPriori data into another application or database.



Reports run from the command line do not need to be installed in aPriori prior to use. You can simply specify the pathname to the .xml input and .xls output files. Note that you should specify any .xls template file with the "templatePath" attribute to the "reports" tag at the top of the .xml file. For example:

```
<reports traverseAssemblies="true"
templatePath="C:\aPriori_templates\report.template.xls">
```

Otherwise the output .xls file will be unformatted; any existing content will be overwritten.

## runAprioriReport.cmd

To generate spreadsheet reports from the command line, you run the runAprioriReport.cmd command, which is found in

```
apriori_install\version\install\bin
```

This command takes seven arguments which must be provided in the exact order shown below. Only the seventh (final) argument is optional.

### Syntax

```
runAprioriReport.cmd co_type co_name xml_report_file xls_output_file
[ scenario_name ] username password
```

### Arguments

*co\_type* -- Cost object type: either part, assembly, rollup, or dynamicRollup .

*co\_name* -- Cost object name:

*xml\_report\_file* -- The full pathname to the XML spreadsheet report definition file.

*xls\_output\_file* -- The full pathname to the Excel file to be populated.

*scenario\_name* -- [Optional] If *scenario\_name* is omitted, "initial" is assumed.

*username* -- The aPriori log-in account name to use for this report session.

*password* -- The associated aPriori password.

### Notes:

1. The order of arguments has changed as of aPriori Release 2018 R1 for compatibility with Single Sign On (SSO): If the optional *scenario\_name* argument is used; it must precede any username and password credentials. If you have existing scripts from release prior to 2018 R1, you must ensure that these arguments follow the new ordering when upgrading.
2. If *username* and *password* are not specified as arguments on the command line, the report utility looks for them in the properties file. If not found there, and if your aPriori administrator has implemented Single Sign On (SSO), the report utility attempts to use the currently logged-in user's Windows credentials.

### Examples

To run a custom report named "XYZ" that resides in folder named C:\Files, from the command line, and generate an Excel file named "results" in the same folder, for a part named "r5":



```
runAprioriReport.cmd part R5 C:\Files\XYZ.watchpoints.xml
C:\Files\results.xls initial user1 user1passwd
```

To run the system-defined Cost Driver report from the command line and generate an Excel spreadsheet in a folder named "files", for a part named R6:

```
runAprioriReport.cmd part R6 "apriori_install\ext\cost-watchpoint-
report\watchpoints\Cost Driver.watchpoints.xml" c:\files\results.xls
initial user1 user1passwd
```

## Troubleshooting FAQ

This section identifies some common issues you may encounter when running aPriori spreadsheet reports.

**Q:** I've created an .xml report file, but I cannot install it using **Tools>Spreadsheet Reports>Install Spreadsheet Reports**. Why can't I install it?

**A:** *You need to compress the XML report file and its associated .xls template file (if any) into a .zip file before the Install command will recognize it.*

**Q:** I successfully installed my new report file, but I cannot see it in the drop-down menu when I use **Reports>Spreadsheet Reports**. Why?

**A:** *Ensure that the XML file name ends in ".watchpoints.xml". The **Reports** pulldown menu ignores any file that does not follow this convention.*

**Q:** I want to run a report but the **Reports>Spreadsheet Reports** menu option is greyed out. Why?

**A:** *You must have a part, assembly, or rollup open in aPriori before this menu option becomes active.*

**Q:** I have defined a spreadsheet template file and included it in my .zip file and successfully installed it. But when I run my report, the spreadsheet has no formatting -- just raw data. What's wrong?

**A:** *The XML file needs to explicitly specify the path to its template file with the `templatePath` attribute to the `<report>` tag. Ensure that this attribute exists and does not contain any typos. Also ensure that the extension is correct (.xls or .xlsx or .xlsm).*

**Q:** Where can I find a comprehensive list of all the variables I can use in these reports?

**A:** *See "Figuring Out What Variables to Use" on page 330.*

**Q:** I'm seeing some odd values in my reports, possibly related to formatting issues. Is there something that I am overlooking?

**A:** *If you are using Excel Version 2003, try upgrading to Excel Version 2010. The aPriori-provided templates for all reports EXCEPT Component Sourcing (component.sourcing.report.template.xls) are 2010-compatible .xlsx files.*

**Q:** I successfully created and ran a custom spreadsheet report, but when I tried to open the spreadsheet, Excel displayed the following error: "Excel found unreadable content in <filename.xls>..." But I cannot see anything wrong with my XML file. What is causing this error?

**A:** *One subtle cause of this problem can be multiple instances of the same formula within different nodes, but with different upper- and lower-case conventions. For example, in the example below there is an instance of "aggregateCost", followed by a second instance spelled "aggregatecost":*

```

<Node name=" Progressive Die " isProcess="true" level="process"
suppressZeros="false">
  <CSL>
    <Formula> targetCost </Formula>
    <Formula> aggregateCost </Formula>
    <Formula> targetCostDelta </Formula>
  </CSL>
</Node>
<Node name=" Transfer Die " isProcess="true" level="process"
suppressZeros="false">
  <CSL>
    <Formula> targetCost </Formula>
    <Formula> aggregatecost </Formula>
    <Formula> targetCostDelta </Formula>
  </CSL>
</Node>

```

*In this example, the different cases of the same formula (marked in red) will cause unreadable data to be output to the Excel file. This problem can be difficult to find, as the individual formulae will work fine without the conflicting formulae. The best way to avoid this is to ensure that the case used is consistent.*

## XML Configuration File Reference

Here is an example of an XML configuration file that defines an aPriori spreadsheet report.

```

<?xml version="1.0" encoding="utf-8"?>
  <reports templatePath="templates/costdriver.report.template.xls"
  traverseAssemblies="true">
    <CostModelWatchpoints sheetName="directCostsData">
      <Node name="*" isLeaf="true" suppressZeros="false" tag="first">
        <CSL>
          <Formula>materialCost</Formula>
          <Formula>laborCost</Formula>
          <Formula>directOverheadCost</Formula>
          <Formula>setupCostPerPart</Formula>
          <Formula>expendableToolingCostPerPart</Formula>
          <Formula>targetCost</Formula>
        </CSL>
      </Node>
    </CostModelWatchpoints>
    <CostModelWatchpoints sheetName="cycleTimeData">
      <Node name="*" isLeaf="true" suppressZeros="true" tag="2nd">
        <CSL>
          <Formula>cycleTime</Formula>
        </CSL>
        <OperationNodes >
          <Node name="*" isLeaf="true" suppressZeros="true"
            tag="3rd">
            <CSL>
              <Formula>cycleTime</Formula>
            </CSL>
            <GcdTypes>
              <Gcd name="*" />
              <Gcd name="CurvedWall"><Attribute>direction

```

```

        </Attribute></Gcd>
      </GcdTypes>
    </Node>
  </OperationNodes>
</Node>
</CostModelWatchpoints>
</reports>

```

## Column Headings

If the generateOneRowPerAttribute attribute on the CostModelWatchPoints element is set to “true”, each worksheet into which data is output contains the following columns. (If set to “false”, then columns for each value that would have appeared under the “formula” column are added to the spreadsheet.)

- bomLineNumber -- This is a number starting from 1 (from 2 in the case of rollups) that is unique to each part/assembly for which rows are generated.
- bomDepth -- beginning with "1" this number is incremented by one for each level in an assembly/rollup. Thus, immediate children of a top-level assembly will be at level 2, their children will be at 3 and so on.
- Part Number -- Self-explanatory.
- Cad File Name -- Self-explanatory.
- Scenario -- Default is “initial”.
- ScenarioType -- Rollup, part, or assembly. Note: Since aPriori doesn't generate any data for rollups other than the parts and/or assemblies that they contain, "rollup" never actually appears.
- ScenarioFullName – When generateStandardColumns="true", output format is "partNumber.scenarioName". If generateStandardColumns="false", the line "<Formula Heading="ScenarioFullName">displayName</Formula>" returns "partNumber.scenarioName" for virtual parts, and the Node value of process group/routing (e.g., "Sheet Metal/Machining") for a costed CAD part. Consider using "<Formula>componentName</Formula>" instead.
- VPE -- This is blank if the row represents a gcd attribute value.
- ProcessGroup -- This is blank if the row represents a gcd attribute value.
- Process -- The process or operation name from which the cost output has been generated. This is null if the row represents a gcd attribute/value
- Level -- One of "component", "process" or "operation".
- Leaf -- Boolean value. Set to true if the process/operation is a leaf node in a template.
- HasChildren -- Boolean value. Set to true if the process/operation has child operations for which data has been output in this report. Note that this is a value that is computed while the report is being generated, not from the process model. Use this if your output includes, for instance, both "3 Axis Mill" and "Milling" and you want to create a pivot that picks up just "milling" or just "3 Axis Mill".
- Node -- The name of the Node represented by this row in the report (blank for gcDs).

- GcdType -- The type of the gcd represented in this row. This could be either the gcd type for the operation from which we're grabbing an output or the type of the gcd whose attribute we're printing out.
- Gcd -- The name of the actual gcd
- Gcd Display Name -- Self-explanatory.
- CostView -- The costview from which this report was generated ("current", "last saved", "previous"). Will generally be "current".
- Tag -- The value of the tag generated for this row (see below in the xml language spec).
- formula -- The name of the formula (or gcd attribute) represented by this row. (not present if generateOneRowPerAttribute is set to false)
- Value -- The value represented by the row. (not present if generateOneRowPerAttribute is set to false)

Again, if the generateOneRowPerAttribute attribute on the CostModelWatchPoints element is set to false, then the formula and Value columns are replaced by a single row for each node or GCD, containing columns for each specified attribute.

## <reports>

### Attributes:

- templatePath - the relative file path to the Excel template to be used as the basis for generating data. If this is blank, no template is used.
- traverseAssemblies -- if true, the data generation will traverse into assemblies generating data not only for the assembly itself but for contained subassemblies and parts (this is exhaustive and there's no way to specify how many levels down to go at this point).
- generateXml -- if true, the report output will be generated as an XML document as opposed to an Excel spreadsheet.
- generateCsv -- if true, the report output will be generated as a comma-separated values (CSV) document as opposed to an Excel spreadsheet.
- useTabSeparator -- When used with generateCsv, the columns will be separated by tabs rather than commas.
- outputDir -- full path to the directory the output will be saved in, this will be used if the directory exists and the user doesn't change the directory through the file chooser.
- outputName -- save name of the file, this will be used if the user doesn't modify it in the file chooser.
- promptSave -- defaults to true; if false, no dialogs are displayed after selecting the report to generate. outputDir must be specified if this is set to false. Since the file chooser usually handles overwriting but is now suppressed, files sharing names will be saved as duplicates (foo(1).xls, foo(2).xls, etc.). WARNING: as part of suppressing the "Would you like to view the report?" dialog, error dialogs

are also suppressed, so the user needs to be aware of any reports that don't generate.

- `fileExtension` -- specify `.xls`, `.xlsx`, or `.xlsm` for Excel reports, this will be forced. `templatePath` extensions will always take precedence over this property.
- `appendDateToOutput` -- if true, concatenate a date timestamp onto the end of the file before the extension.
- `dateFormat` -- customize formatting for the date timestamp, such as `"YYYY-MM-dd_hh-mm-ss"`

Notes about `generateCsv`: If both `generateXml` and `generateCsv` are set to true, XML takes precedence.

If you set the `generateCsv` to true, a `.csv` file will be generated for each `<CostModelWatchPoints>` element. The name of the file will have the `sheetName` appended to the name that you give to the file in the UI. The contents of the summary tab will end up in a file that just contains the root filename.

For example, if you select `"myPartCostTracking.csv"` as the filename, then `myPartCostTracking.csv` will contain the summary tab, while `myPartCostTracking_sheetName.csv` will contain the data that would have gone into `sheetName` had this been Excel output.

Both CSV and XML output is streamed to disk so unlike Excel does not build any in-memory structures before writing the data to disk.

## Child Elements:

`<CostModelWatchpoint>` (one or more)

# <CostModelWatchpoints>

## Attributes:

- `sheetName` -- The name of the tab into which to output the data. This is a required attribute. aPriori recommends that you use `"ap_output"` as a default.
- `rangeName` -- The name of the "named range" to create in Excel representing the data output by this `CostModelWatchpoint` element. If `rangeName` is null, a range will be created using `sheetName`.
- `generateOneRowPerAttribute` -- If set to `"false"`, the spreadsheet will contain one row per node or gcd with the attribute values as separate columns rather than one row per attribute/value pair.
- `revisitScenarios` -- If set to `"true"`, the system will not filter out duplicate visits to scenarios. This could occur while traversing assemblies for example, and if what you want to do is aggregate costs or deal with counts of scenarios in an assembly or rollup you will have to revisit them. (more about aggregation attributes below).
- `suppressRollups` -- If set to true, the system will not generate a row for the rollup itself in the cost outputs.

- generateStandardColumns -- Defaults to true. If set to False, the system will not generate the standard set of columns and it is up to the report author to make sure that there is enough key information in each generated row to make appropriate distinctions. Attributes that get generated as standard outputs can now be named explicitly and generate the following columns:
  - bomLineNumber
  - bomDepth
  - Part Number
  - Scenario
  - ScenarioType
  - ScenarioFullName
  - VPE
  - ProcessGroup
  - Process
  - Level
  - Leaf
  - HasChildren
  - Node
  - GcdType
  - Gcd
  - Gcd Display Name
  - CostView
  - Tag
- generateFailedOperationResults -- Defaults to false. If true, data for failed operations is generated.
- generateSetupAxes -- If you want to generate rows to represent all the setup axes in the part, set this to true. You cannot select which attributes to get out of setup axes: you get all of them.
- generateDtcMetrics – Defaults to false. If true, all Design to Cost (DTC) metrics appropriate for each scenario will be output on the component row where they can be accessed for Cost Insight Report Ad Hoc reports. Has no effect on OOB Reports.
- outputDuplicateProcAndOpData -- If you want to generate duplicate rows for process & operation output, revisitScenarios must be set to true for this to have any affect.

## Child Elements:

<Node> (one or more)

## <node>

### Attributes:

- name - the name of the process/operation for which this node specification applies. "\*" means all nodes.
- processGroup - the name of the process group for which this operation applies. Defaults to all.
- isLeaf - if true, only generate the specified output for leaf nodes
- level - one of "component", "process", "operation" - not relevant yet (future expansion)
- tag - optionally, the tag to generate for each row within this Node spec. Note that if the node spec contains another node spec by virtue of OperationNodes, then the embedded node spec will not inherit the tag value of this node.
- isProcess - if true, only nodes that represent processes will be processed
- isOperation - if true, only nodes that represent operations will be processed.

### Child Elements:

<CSL> (only 1 allowed)

<OperationNodes> (only 1 allowed)

<GcdTypes> (only 1 allowed) This works whether it is in a <Node> within an <OperationNodes> element. If it isn't within <OperationNodes>, the only relevant <GcdType> will be Component.

## <OperationNodes>

### Attributes:

None

### Child Elements:

<Node> (one or more)

## <CSL>

### Attributes:

- getAllFormulas - if true then no <Formula> child nodes are needed, and a row will be generated for every single cost model output for the current node.
- suppressZeros - no row will be generated for any <Formula> that has a value of 0.

- suppress - if true, no CSL outputs will be generated for the current node.

## Child Elements

<Formula>

<Macro>

## <Formula>

There can be zero or more <Formula> elements as children of the <CSL> element. The value of each element must be the name of an output for which a row should be generated.

**Note:** It is impractical to list all the possible formula values. To extract a list of all valid formula values for the current node, run a report that specifies the `getAllFormulas` attribute to the <CSL> tag. See "Figuring Out What Variables to Use" on page 330.

### Attributes:

Heading -- If supplied, this becomes the column heading if `generateOneRowPerAttr` is TRUE, or it becomes the value of the "attribute" column if `generateOneRowPerAttr` is false. If no heading is supplied, the formula (attribute) name is used as the heading.

## <MACRO>

Specify an Excel formula to be output. Can be used within both the <CSL> and <Gcd> tags.

### Attributes:

Heading -- If supplied, this becomes the column heading if `generateOneRowPerAttr` is TRUE, or it becomes the value of the "attribute" column if `generateOneRowPerAttr` is false. If no heading is supplied, the formula (attribute) name is used as the heading.

## <GcdTypes>

The <GcdTypes> element (which is always a child of a <Node> and potentially a sibling to a <CSL> node) serves two roles: it specifies which (or possibly all) the Gcds for which CSL outputs are to be generated, but can also specify which Gcd attributes should be generated into the current sheet as well.

One can have a <Node> element with only <GcdTypes> as children. (In fact, one can use this approach to create a worksheet with just GCD attribute values and no CSL output values).

### Attributes:

None



## Child Elements:

<Gcd>

# <Gcd>

## Attributes:

- name -- the name of a Gcd type (such as "CurvedWall" or "PlanarFace"), or "\*" for all.
- getAllAttributes -- specifies that you want every attribute output for the Gcd. Analogous to getAllFormulas in the CSL element.
- generateRelations -- if true, a row is generated for each relation that this gcd has. There is no way to specify which attributes. The code generates them all.

## ChildElements:

<Attribute> is an exact analog of the <Formula> element inside a <CSL> construct.

# <Attribute>

This performs the same function for the <Gcd> tag that <Formula> performs for the <CSL> tag. See "<Formula>" on page 346 for more information.

**Note:** It is impractical to list all the possible attribute values. To extract a list of all valid gcd attribute values for the current node, run a report that specifies "getAllAttributes="true" to the <gcd> tag.

# Glossary

Actual Tool	A tool that is either available at the machining area being modeled or available in a machine tool catalog. Actual tools usually have a make (for example, Kennemetal) and a model (for example, Corobore 860). A particular model is available in a series of sizes (usually diameters).
Amortized Investment	The amortized sum of all fixed costs. Fixed costs must be incurred before the start of production. In aPriori, all fixed costs are amortized to the individual part or assembly by dividing the total, up-front cost for the fixed cost (the capital cost) by the Total Product Volume.
Annual Volume	The total number of parts or assemblies of a specific design produced in one year.
Arc Welding	A welding process that uses the concentrated heat of an electric arc between an electrode and the base material to melt the metals at the welding point. Depending on the material to be welded, either direct or alternating current may be used for the arc, and consumable or non-consumable electrodes.
Assembly	An assembly of parts as defined by the MCAD system part/assembly tree. Normally, an assembly has more than one part. Technically, however, the MCAD system might allow an assembly with only one part. Parts in assembly are oriented to one another and secured by an assembly process, such as welding or snap-fit. An assembly cost object comprises the costs of all the member parts or sub-assemblies associated with it, as well as the cost of the orientation and securing of the members in the assembly. Costs of assembling the sub-assembly components are included in the total cost of those components.
Batch Size	The number of parts in a Set-up Batch. Typically, batch sizes represent one month of sales.
Bounding Box	A prismatic box enclosing the final part shape. The orientation of the bounding box determines the minimum stock size and the orientation of the part within the stock.
Bulk Removal Factor	A value used to compute the diameter of the default bulk removal tool and the characteristics of the bulk removal skin.
Cache	See "Document Cache".
Capital Investment	The total amount a company must invest in fixed costs before the first part or assembly can be made. This cost is 'fixed' because the company incurs the cost whether it makes one part or the total number of parts allowable before tooling must be refurbished or replaced.
Casting	The process of forming an object by pouring material into a mold, where it solidifies. Also, the process of forming a film or sheet by pouring a liquid onto a moving belt or by precipitation in a chemical bath.

Cavity	The space inside a mold into which material is injected.
Computer-Aided Design (CAD)	Software applications that enable interactive engineering drawing and electronic storage of mechanical designs including geometry, physical configuration, materials of construction, etc.
Cost Comparison	A tabular list of each member of the Comparison (rows) and the associated cost/time information (columns).
Cost Estimating	The process of calculating the probable cost of a product or service, including labor, material, vendor/supplier costs, and applicable rates and factors.
Cost Object	An entity that has costs associated with it. aPriori has three different types of cost objects: parts, assemblies, and Cost Roll-ups.
Cost of Goods Sold (COGS)	The direct expenses incurred in producing a particular good for sale, including the actual cost of materials that comprise the good, and the direct labor expense in putting the good in salable condition. COGS does not include indirect expenses such as office expenses, accounting, shipping department (although it may contain shipping costs), advertising, and other expenses that cannot be attributed to a particular item for sale. COGS for a manufacturing company will include things like basic materials plus the costs of production, supplies, and labor.
Cost per Part	Cost of tooling amortized at an individual component (part or assembly) level by Total Production Volume.
Cost Roll-up	A list of components (parts and assemblies) and their associated costs/times.
Cost Target	The cost target for the component (part or assembly)
Cost Taxonomy	The structure and linkages within aPriori that describe different Cost Categories. The Cost Taxonomy is canonically defined by aPriori. All parts of the Cost Taxonomy are linked; however, not all are directly additive. The Cost Taxonomy is the “architecture” of cost in aPriori.
Currency	A unit of cost. The default currency is US dollars.
Cycle Time	The actual time that a machine/process is operating on a given component (part or assembly).
Die Casting	A metal shaping process in which molten metal is forced into a reusable mold and held under pressure until it solidifies.
Direct Overhead	Costs associated with manufacturing of a specific part on a machine, such as, the machine's power costs, depreciation, maintenance, and so on, based on time.
Document Cache	A folder in which VPE information is saved from the database. This cache improves the performance of aPriori, especially when the clients are not located within the same LAN as the database server. It eliminates the need to extract large amounts of data from the database each time a part is costed. See the <i>aPriori System Administration Guide</i> for information about doc cache cleaning options.

Exchange Rate	Refers to the factor applied to equate one currency amount to another currency amount. For example, 1 USD = 1.1895 Euro.
Expendable Tooling	Tooling that is consumed during manufacturing, but not tied to a specific part. For example, a drill bit, turret press punch, etc. is used in the manufacture of many different part designs.
External Groove	A circular continuous channel cut into an external feature of a part.
External Thread	A thread that is formed on an external feature of a part.
Extraction	The use of a solvent to remove (extract) one or more components from a mixture; generally, the process of removing a desired or undesired constituent.
Extrusion	The process of forming rods, tubes, or other continuously formed pieces by pushing hot or cold semisoft solid material through a die.
Facility	The selection name for a Virtual Production Environment (VPE).
Fixtures and Jigs	Devices used to hold a part or an assembly in the correct orientation on a machine during manufacture or assembly. Fixtures and jigs under the Fixed Cost category are created for a specific design. It is assumed that these fixtures will not be re-used on a different design in the future.
Forging	A process where the desired shape is accomplished by forming in presses, hammers, rolls, upsetters, and related machinery to deform the workpiece.
Forming	The process that produces a useful shape by making any change in the shape of a metal piece which does not intentionally reduce the metal thickness. The term covers all operations required to form a flat sheet into a part, including deep drawing, stretching, bending, and buckling in the context of sheet metal.
Geometric Cost Driver (GCD)	A geometric attribute in the solid model of a component (part or assembly) that drives cost on the manufacturing floor. A GCD may be a discrete concept such as the thickness of sheet metal or the finished mass of a cast part, or it may be a high level human geometrical concept such as a bend, hole, pocket, fillet, draft angle, etc.
Grinding	The process that removes material from a workpiece using a grinding wheel or coated abrasives.
Grooving	A process in which grooves are cut to a specified depth in one pass by a form tool. Grooving does not sever a complete section from the workpiece.
Hard Tooling	Capital or hard tooling are tools that are purchased for creating one specific design and cannot be used to create other designs.
Hot Runners	Runners that are insulated from the chilled cavities in a mold and are kept hot. Hot-runner molds make parts that have no scrap.

Injection Molding	A shaping process in which thermoplastic material is fed into a heated barrel, mixed, and forced into a mold cavity, where it cools and hardens to the configuration of the mold cavity.
Internal Groove	A circular continuous channel cut into an internal feature of a part.
Internal Thread	A thread that is formed on an internal feature of a part.
Labor Cost	The amount that labor is paid to manufacture the part or assembly. During the building of a VPE, the customer determines which components of labor compensation are included in the labor rate that is used to calculate labor cost. However, labor cost usually includes hourly wages and benefits.
Labor Time	The time that a person is paid to perform an operation/process on one component (part or assembly).
Lifter	A mechanism for raising a part in a die or mold to a height for advancing it to another station, or for ejecting it from the die or mold.
Machine	The aPriori representation of a physical machine in a manufacturing facility.
Machining	The process in which a shape is generated by removing unwanted material. Shape restrictions exist for some machining processes. For example, turning can only produce axisymmetric shapes.
Machining Operation	An action performed as part of a machining technique. Typically, an operation is performed with a single tool.
Machining Technique	A description of the method used to manufacture a GCD. Some GCDs, such as holes, may be manufactured with a variety of techniques, each technique having its own scope of use and advantages. A machining technique typically requires one or more manufacturing operations to be performed.
Manual Arc Cost	The cost associated for a person to perform only the arcing to MIG weld one assembly.
Manual Arc Time	The time for a person to perform only the arcing to MIG weld one assembly.
Manual Cycle Time	The time for a person to perform all the tasks to weld one assembly (for example, loading, clamping, arcing, etc.).
Manual Spot Cost	The cost associated for a person to perform only the arcing to spot weld one assembly.
Manual Spot Time	The time for a person to perform only the arcing to spot weld one assembly.
Material	The chemical composition/alloy/name of the material of which a part is made.
Material Composition	The specific chemical composition of the material in industry standard terms (for example, ANSI spec, such as 1020 Hot Rolled Q1).

Material Cost	The cost of the physical material used in the manufacture of the part. Material Cost includes both the material in the physical part and an allocation of scrap material that is wasted during the manufacturing process. Material cost does not include consumable material (for example, weld wire, adhesives, etc.), only primary material.
Material Stock	The physical size of the piece from which a part is made (for example, sheet size for sheet metal, rod diameter and length for a shaft). For net form processes such as injection molding and casting, sizing is not applicable.
Material Type	The general class of metal (for example, Steel, Nylon, Brass, Aluminum, etc.). Although type is really a parent class, it functions as an attribute of composition in aPriori, rather than its parent.
Material Utilization	A measure of waste in manufacturing defined as: Gross Mass of a Part \ Rough Mass
Mechanical Computer-Aided Design (MCAD)	Refer to Computer-Aided Design (CAD).
MIG Gun Manipulation Cost	The cost associated with manipulating the MIG gun.
MIG Gun Manipulation Time	The time allowance for a person to move between welds, clean, and manipulate the MIG gun.
MIG Welding	Metal Inert Gas (MIG) welding is often referred to as wire-feed welding. It is a commonly used high deposition rate welding process. During the welding process, wire is continuously fed from a spool. MIG welding is sometimes referred to as a semi-automatic welding process.
Milling	A cutting process in which material is removed from a workpiece by a rotating tool.
New Product Introduction (NPI) Process	The process of introducing new products to market. It spans the entire product life cycle from initial identification of market/technology opportunity, conception, design and development through to production, market launch, support, enhancement and retirement.
Non-Geometric Cost Driver	A driver of part or assembly cost not directly tied to geometry. Examples include the factory of the supplier at which the part is made, selected routings, selected machines, production volume, and so forth.
Number of Years	The number of years that the component (part or assembly) will be produced.
Other Direct Cost	Other costs that can be specifically associated with the manufacture of a given design. In contrast, indirect cost or period overheads (not covered in aPriori) are expenses such as rent or lighting that are not easily allocated to a specific design. In an accounting system, direct

	costs typically become part of Cost of Goods Sold, whereas indirect costs are expensed every financial period as part of Sales, General, and Administrative (SG&A) expense. Other direct costs could be preventative maintenance expenses tied to a given machine, a material handling additive, and so forth.
Part	A single component that cannot be further subdivided into other cost object, as opposed to an assembly.
Part Number	The unique component (part or assembly) identifier, typically specified as the CAD file name. Note that this may or may not actually include a part number.
Parting Line	The location where two mold halves meet when they are closed.
Piece Part Cost	The marginal cost associated with making “one more” part of a given design. Piece part cost includes all Variable Costs associated with a parts creation but does not include depreciation of capital tooling. It does include expandable tooling.
Pocket Removal Factor	Used to compute the pocket roughing tool diameter and the characteristics of the pocket's removal skin.
Process	The type of manufacturing process that a machine performs (for example, Laser Cut, Standard Press, Plasma Cut, and so forth). Each machine has a process type and there may be many machines of the same process in a given Virtual Production Environment (VPE). aPriori uses three letter codes to denote processes (for example, Cut-to-Length = CTL, Laser Cut = LAS, and Bend Brake = BND).
Process Cost	The cost associated with a particular type of manufacturing process that a machine performs.
Process Formula	The aPriori logic and formulas that read Geometric Cost Drivers (GCDs) and non-geometric cost drivers as input in order to calculate time and cost.
Process Group	A group of processes of the same manufacturing type. For example, the Sheet Metal process group includes such processes as Laser Cut, Bend Brake, Shear, and so forth. Parts may often be completely manufactured using processes in one process group only. Other times a part or an assembly will require multiple process groups (for example, Casting, Machining, and Surface Treatment).
Process Routing	A sequence of processes that are used in sequence to add a group of manufacturing features to a part, and often, to complete the manufacture of a given part or sub-assembly (for example, CTL/LAS/BND).
Procurement	The body of activities and processes associated with acquiring materials, goods, and services to support the operation of the enterprise.
Programming Time	Many modern machines are Computer Numerical Control (CNC) machines that follow a computer program to make or assemble parts. A program needs to be created once (therefore, it is part of Fixed Cost).

Robot Arc Cost	The cost associated for a robot to perform only the arcing to MIG weld one assembly.
Robot Arc Time	The time for a robot to perform only the arcing to MIG weld one assembly.
Robot Cycle Time	The time for a robot and its operator to perform all the tasks to weld one assembly (for example, loading, clamping, arcing, etc.).
Robot Spot Cost	The cost associated for a robot to perform only the arcing to spot weld one assembly.
Robot Spot Time	The time for a robot to perform only the arcing to spot weld one assembly.
Rough Mass or Weight	The mass of all the material that was needed to get to the final state of the part. The sum of Finished Mass + Gross Part Mass + Mass of Stock Scrap.
Routing Entries	The list of Process Routings associated with a Virtual Production Environment (VPE).
Routing Formulas	Refer to Routing Rules.
Routing Rules	The heuristics (typically Boolean) that help aPriori to determine if a Process Routing is capable of manufacturing a given cost object by looking at the physical capabilities of a machine. For example, if a Sheet Metal Process Routing contains a Turret Press process, aPriori verifies that at least one of the turret presses in the Virtual Production Environment has the force to punch through the given thickness of the sheet metal. If not, this Process Routing is eliminated from the analysis.
Scenario	An instance of a Full Cost Driver Record that is dynamic (that is, non-geometric cost drivers can be modified to regenerate cost completely independent of CAD). In addition, it can have new GCDs applied to it and be evaluated with the current set of non-geometric cost drivers.
Scrap	Scrap is unused material that is commonly thrown away as useless material or sold to a scrap merchant. Scrap may be part scrap (considered inherently part of the material needed to produce the part) or stock scrap (scrap that is not “part of the part” - for example, internal holes, that could possibly be used for other parts).
Set-up Batch	The number of parts run before machines must be set up for new or different parts.
Set-up Cost per Part	The cost to set up a machine for a new batch of parts.
Set-up Time	The time to set up a machine for a new batch of parts.
Set-ups	The cost in machine downtime and labor incurred when a machine is configured to run a batch of a given design. This cost is amortized to individual parts or assemblies by the number of parts in a batch.
Side Cores	Used when molding parts in cavities not perpendicular to the direction in which the part is ejected from the mold. The cores are



	automatically pulled from the mold prior to the mold opening and reinserted when the mold closes again and prior to injection.
Spot Gun Manipulation Cost	The cost associated with manipulating the spot-welding gun.
Spot Gun Manipulation Time	The time allowance for a person to move between welds, clean, and manipulate the spot-welding gun.
Spot Welding	The process in which contacting metal surfaces are joined by the heat obtained from resistance to electric current flow. Workpieces are held together under pressure exerted by electrodes.
Stock Form	The physical form of the stock such as sheet, coil, hex bar, rectangular billet, pellet, etc. Note that stock form does not apply to net form processes (for example, Injection Molding, Casting, Powdered Metals, Extrusions, etc.).
Stock Size	The defining dimensions of the stock form. For example: Sheet — Length, Width, Thickness Rectangular Billet — Length, Width, Height Round Bar — Diameter, Length Pellet — N/A (does not apply to net form processes such as Injection Molding, Casting, Powdered Metals, Extrusions, etc.).
Stock Utilization	A measure of the component's bounding box size relative to the material stock size. If the size gap is above a certain threshold, which indicates excessive material waste, the system may trigger the creation of virtual stock rather than choose actual stock.
Subcomponent	A member of an assembly.
Surface Roughness	The irregularities in the surface texture which result from the production process
Thread Pitch	The number of threads per inch in the Imperial System or the distance between threads in the metric system.
Threading	A machining process that uses a single-point tool to produce a uniform helical thread form on the internal or external surface of a cylinder or cone.
Tool	The general type of tool that is being costed (for example, Blanking Die, Cam-actuated Die, etc.).
Tool Material	The speed at which a tool can cut material depends on the material from which it is made. Two high-level types of tool material are: High Speed Steel and Carbide. High Speed Steel tools are often cheaper but cut slower than Carbide tools. Each tool series has a tool material property.
Tool Series	A tool series is either an actual toolmaker's model milling tool offered in a variety of sizes or a virtual tool for a given tool type provided in a very wide variety of sizes. A tool series has a tool material property.
Tool Type	A general category of machining tool, such as Straight Drill, Flat Bottom Mill, etc.

Turning	The process in which the major motion of the single-point cutting tool is parallel to the axis of rotation of the rotating workpiece, producing cylindrical external surfaces.
Type	The category of tooling under which the tool falls. That is, Hard Tooling (Capital Tooling is treated as a fixed cost) or Expendable Tooling (treated as a direct variable cost).
Virtual Part	A part with no associated CAD model (created directly in aPriori for costing purposes only). A virtual part can be included in roll-ups and comparisons. A virtual part must have a unique name among all components (including CAD-referenced parts and assemblies, and other virtual parts).
Virtual Stock	A placeholder for actual material stock that does not exist for the VPE. Virtual stock is used in an analysis when no reasonably-sized actual stock is available in the VPE.
Virtual Tool	A placeholder for an actual tool that does not exist for the VPE. Virtual tools are used in an analysis when no feasible actual tool can be found or when you prefer to perform an analysis with all virtual tools.
Virtual Production Environment (VPE)	A virtual group of machines, workcenters, processes, process routings, and process groups that represents a production environment at a customer or at a supplier. This representation includes the physical situation (speeds, feeds, manufacturing times) and the cost structure of the VPE (labor rates, overheads, and so forth). Often, all the elements of a VPE would be in one physical location, analogous to a factory. However, this may vary from customer to customer.
VPE	See Virtual Production Environment.
VPE Administrator	The user of the aPriori VPE Administration Client.
Workcenter	An organizational group of machines. A workcenter often contains machines of the same process type which may be closely grouped on the manufacturing floor.





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